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Interpretation of Selected Soil Data from the Central Part of Utah

Amjad T. El-Rihani
Utah State University

INTERPRETATION OF SELECTED SOIL DATA FROM THE CENTRAL PART OF UTAH

by

Amjad T. El-Rihani

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Amjad T. El-Rihani

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ABSTRACT

Interpretation of Selected Soil Data from

The Central Part of Utah

by

Amjad T. El-Rihani, Master of Science

Utah State University, 1977

Major Professor: Alvin R. Southard
Department: Soil Science and Biometeorology

Seventy-eight soil samples belonging to 15 sites were sampled by SEAM project in 1976. These 15 pedons represent different soil types which cover the Manti-LaSal area in the central part of Utah. The 15 pedons were described in standard notation. Complete soil analysis was done. The soil analysis includes the following determinations: particle size distribution, moisture retention, soil pH, organic matter, electrical conductivity, calcium carbonate equivalent, cation exchange capacity, base saturation, extractable cations and saturation extract soluble. Also x-ray diffraction for selected horizons was done.

The 15 pedons were classified according to the currently used system. This report includes the classification and the interpretation of these soils. The purpose of this report is to facilitate planning the management of resources in the Manti-LaSal forest.

(88 pages)

INTRODUCTION

Since time immemorial, man has evaluated land for his own, mainly rural purposes. He placed his houses on high parts of levees in river plains, planted his wheat on well-drained land or his rice where it would be inundated at the proper time.

The last hundred years have seen an ever-accelerating accumulation of data on the suitability of land for different rural purposes. Over the last ten years, a movement has been obvious in the direction of parallel classification for different uses, which enables sound planning decisions to be made where possible uses are competing with one another for the same land.

By now most countries in the world have established their own particular systems of land evaluation, making it difficult for data and experience gained in one place to be transferred to another, even where conditions are similar.

Soil survey interpretations are predictions of performance, not recommendations for the use of the soils. Natural soils differ greatly from place to place. When a soil map shows these differences between the soils, this soil map has little value unless the information from it is used in farming or in some other soil managing activity. This information gives a clear idea about the limitation of the soil for a certain use.

STATEMENT OF THE PROBLEM

The purpose of this report is to classify and interpret soils named and characterized during the operations related to completion of a soil survey of the ECOSYM area on the Manti-LaSal National Forest. These interpretations are not part of the ECOSYM project, but will be used to facilitate planning the management of resources in the Manti-LaSal Forest if and when the activities related to coal extraction are intensified.

LITERATURE REVIEW

The Manti-LaSal National Forest is located to the west of Carbon-Emery area in the east-central part of Utah. Little work has been done in this area, but part of its soils was covered in the soil survey of Carbon-Emery area (1970). Most of the survey area consists of noncultivated soils that surround cultivated areas. It is comprised mainly of rolling hills, narrow valleys, mesa-like remnants of old outwash plains, and steep, rough, broken land.

The raising of beef cattle and sheep is the main source of agricultural income. The main industry is coal mining. Large deposits of coal are in Carbon and Emery counties.

Dry climate, a short supply of irrigation water late in summer, and a short growing season often limit crop production.

Previous soil survey work in Carbon-Emery area to the east shows that the soils occur in association of Entisols, Inceptisols and Aridisols. Soil survey of the Heber Valley area about 30 miles to the north shows that the soils occur in association of Mollisols, Inceptisols, and Alfisols (1976). A similar soil survey study in Utah County (1972) about 20 miles to the west shows the soils occur in association of Mollisols, Alfisols, Entisols and some Aridisols. The last two studies show a large part of the area occupied by Mollisols, whereas in the Carbon-Emery study, a large part of the area was occupied by Aridisols and Entisols.

According to the general soil map of Utah (1975) the Manti-LaSal area is covered by the following soil association:

1. Argic Cryoborolls-Pachic Cryoborills-Cryic Paleborolls association
2. Argic Pachic Cryoborolls-Argic Cryoborolls association
3. Lithic Cryoborolls-Mollic Cryoboralf-rock out crop association
4. Typic Cryorthents-Typic Cryochrepts-Mollic Cryoboralf association
5. Rock land and badland-rock land association
6. Typic Calciorthids-Typic Torriorthent associations

In general, the mountains and plateaus are dominated with Mollisolls, whereas the soils of desert valleys, terraces and fans are Aridisols, Entisols and Inceptisols.

Description of the Area

Location

The study area, which in this report is referred to as Manti-LaSal, is located in the east central part of Utah. It borders on the canyon-land part of the Colorado Plateau. The area consists of high, relatively flat-topped mountains, steep narrow canyons, and sloping alluvial fans. The elevations range from 1900 to 3000 meters above sea level.

Geomorphology*

The Manti-LaSal area can be divided into two parts, the plateau and the desert.

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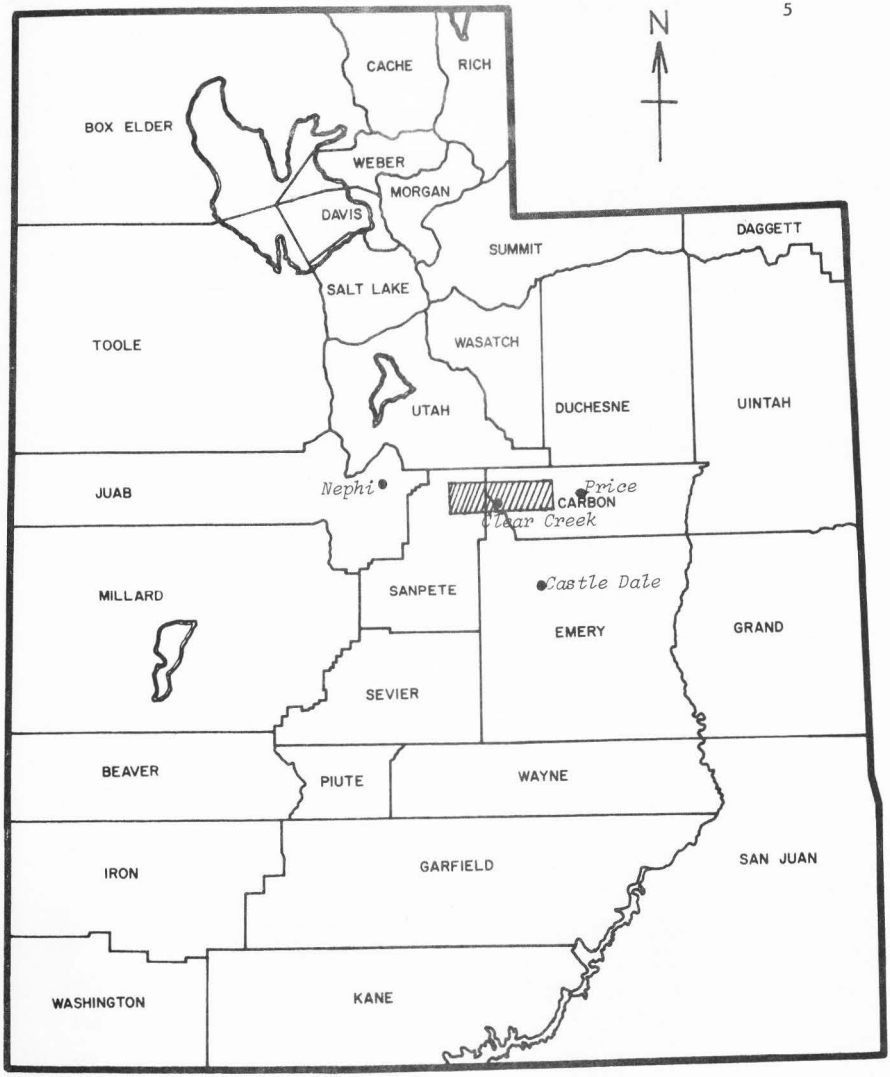
*J. V. DeGraff, personal communication.



Map showing approximate location of study area on the Manti-LaSal National Forest.

Plateau. The plateau is predominantly sandstone formation of Creataceous age. Some of these formations are interbedded with shale and limestone. Some coal beds are also found in these formations.

Much of the plateau has been dissected by fluvial forces. In addition, the canyons draining the east slope of Skyline Ridge were glaciated. This means that at the head of the canyons there has been substantial erosion by ice. This erosion has created over-steepened slopes and also scoured the valley floor. Down the canyons from the head, the valley floor is thinly covered with ground moraine.

Desert benches. The desert is underlain by Mancos formation. This formation is composed primarily of interbedded variable thicknesses of shale and sandstone. The shale is aline. The most important geological feature of these benches is the large amount of fluvial erosion, most of it caused by overland flow. There are pediment surfaces and some stripped structural planes. The pediment and plane surfaces are bounded by steep sided narrow canyons. There appear to be significant accumulations of fine grain wind-blown material locally.

Climate

The climate of Manti-LaSal study region and surrounding area is diverse. The elevation varies from 1525 meters in the valleys to over 3000 meters in the higher mountain regions. When comparing the January and July temperature ranges, the extreme seasonal variation of these months is apparent.

Temperature. In January, the mean maximum monthly temperature ranges from -6 to 3°C, and the minimum monthly temperature ranges from

-10 to -18°C; the mean maximum-minimum range is approximately 21°C. The mean maximum temperature in July ranges from 18 to 32°C, and the mean minimum temperature ranges from 5 to 14°C. The July maximum-minimum temperature range is nearly 28°C.

The wide variation of temperature results from daytime surface heating and radiative heat loss at night, forming temperature inversions. Temperature inversions predominate in the valley bottoms and in topographically suitable canyon profiles in the higher elevations.

Precipitation. The mean monthly precipitation in the Manti-LaSal Forest ranges from approximately 40 mm in July to over 150 mm in January. In the higher elevations the precipitation maximum occurs in the winter months (December-March). The annual precipitation ranges from 200-300 mm in the valley, 300-500 mm in the bench areas, to greater than 500 mm in the higher elevations.

Snowfall. Snowfall distribution in the region is quite variable. It ranges from 36 cm to over 540 cm. At the valley bottoms snowfall varies approximately from 40-140 cm; the bench areas obtain from 140-250 cm; and the higher elevations receive greater than 250 cm.

Winds. The winds in the study area are primarily a function of local terrain features. Based on the information obtained in the summer of 1976, the general wind conditions at the Wiregrass bench location were predictable from a knowledge of the relationship of wind to topography. In the morning and evening hours the wind was predominantly from the west (downslope) and the average wind velocity was 1.5 m sec^{-1}. The afternoon hours indicated a southeast component of wind (upslope) with an average velocity of 4.5 m sec^{-1}.

At the upper elevation location (Ridley Ridge), the wind was highly variable. Generally the wind had a south and southeast component in the morning and evening with an average wind velocity of 6 m sec^{-1}. In the afternoon the wind is usually from the west and southeast with an average wind velocity of 6 m sec^{-1}. Temperature and precipitation in Castledale and Clear Creek are presented in Table 1.

Vegetation

The vegetation in Utah varies widely from one part of the state to another, the kind and amount closely associated with climate and topography. The major forest areas occur in the high mountains where the climate is humid and the mean annual rainfall is 500 mm or higher. Therefore, the dominant trees in the high mountains of Manti-LaSal area are Douglas Fir, Alpine Fir, Englemann Spruce, Lodgepole Pine, Quaking Aspen, and some Bigtooth Maple. Ponderosa Pine is prominent in some of the mountains and plateau areas where the average annual precipitation is 350-500 mm. Pinyon Pine and Utah Juniper are the dominant vegetation that occur mainly on mountain slopes, plateau and foothill terraces where the average annual precipitation ranges from 300-400 mm. Most of these trees have understory of associated grasses, forbs, and shrubs.

The lower valleys, plains, mesas and plateau, of the Manti-LaSal region, where the climate is semi-arid or arid and average annual precipitation is less than 300 mm, are dominated by grasses, shrubs and forbs. The dominant grasses are Indian Ricegrass and Squirreltail.

Table 1. Temperature and precipitation in Castle Dale and Clear Creek.

Castle Dale (elevation 1710 meters)													
Item	J	F	M	A	M	J	J	A	S	O	N	D	Ann.
Ave. T. °C	-7.3	-3.3	2.8	7.5	12.5	17.4	20.8	19.6	14.6	8.3	1.9	-.5	7.8
Prec. mm	17.9	17.9	15.3	15.3	15.3	12.7	25.5	30.6	22.9	20.4	12.7	15.3	22.2
F.F. P = 119 days													
Clear Creek (elevation 2530 meters)													
Ave. T. °C	-8.2	-7.0	-4.7	1.6	6.6	10.1	14.6	13.8	9.3	3.3	-1.0	-7.3	2.6
Prec. mm	63.4	56.0	48.4	45.9	38.3	33.0	45.9	43.4	40.8	45.9	33.2	43.4	53.8
F.F. P = 57 days													

Use and Management of Soils

The soils of the Manti-LaSal region are used chiefly for range and some for irrigated hay and pasture. Most of these soils are well supplied with potassium, calcium, iron, and magnesium. Siols that formed from shale are rich in illite and kaolinite clays.

The water table is deep and most of the soils are well drained with moderate to high permeability. Thus, drainage is not needed.

Capability Groups of Soils

Capability classification is a grouping of soils according to their limitations and response to management, to show in general way, their suitability for most kinds of farming.

In the capability system, all kinds of soils are grouped at three levels, the capability class, subclass, and unit.

Capability classes. The classes are defined as follows:

Class I: Soils have few limitations that restrict their use.

Class II: Soils have some limitations that reduce the choice of plants or require moderate conservation practices.

Class III: Soils have severe limitations, that reduce the choice of plants, require very careful management, or both.

Class IV: Soils have very severe limitations that restrict the choice of plants, require very careful management, or both.

Class V: Soils subject to little or no erosion but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland or wildlife food and cover.

Class VI: Soils have severe limitations that generally make them unsuited to cultivation and limit their use largely to pasture

or range, woodland or wildlife food and cover.

Class VII: Soil have very severe limitations that make them unsuited to cultivation and that restrict their use largely to grazing, woodland, or wildlife.

Class VIII: Soils and landforms have limitations that preclude their use for commercial plant production and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

Capability subclass. Subclasses are soil groups within one class. They are designated by adding a small letter e, w, s, or c, to the class numeral. The letters e, w, s, or c, refer to erosion, water soil, or climate limitations, respectively. Example: IIe-2, irrigated. The letter e shows that the main limitation is risk of erosion unless close-growing plant cover is maintained.

Capability units. Capability units are soil groups within the subclass. The soils in one capability unit are enough alike to be suited to the same crop and pasture plants, to require similar management and to have similar productivity and other response to management. Example: VIIe-D3X. The Roman numeral designates the degree of limitation, and the small letter immediately following, the subclass or kind of limitation. The part of the symbol following the hyphen identifies the capability unit in the state system.

In the Utah system a number or letter is used to suggest the chief kinds of limitation. The numbers 0 through 4 in the first position show the climate. The letters H, M, U, S, and D in the first position, are for the nonirrigated capability units, and show the range of average annual rainfall. The numbers and letters are

expressed as follows:

Climate-irrigated.

0: 190 frost-free days

1: 150-190 frost-free days

2: 100-150 frost-free days

3: 70-100 frost-free days

4: 45-70 frost-free days

Nonirrigated-Range.

H: Climate equivalent to high mountain range sites with mean annual precipitation more than 350 mm.

M: Climate equivalent to mountain range sites with mean annual precipitation less than 350 mm.

U: Climate equivalent to upland range sites with mean annual precipitation 225-350 mm.

S: Climate equivalent to semi-desert range sites with mean annual precipitation 150-225 mm.

D: Climate equivalent to desert range sites with mean annual precipitation less than 150 mm.

Additional numbers or letters are used to show other limitations as follows:

1: Historical erosion, wind or water.

E: Erosion other than those above.

2: Overflow or inadequate surface drainage.

W: Beneficial water table.

B: Blank.

3: Soil depth to inhibiting layer.

4: Coarse fragments below surface.

5: Restricted permeability or poor aeration.

6: Very rapid permeability, droughty, low AWC.

7: Salinity.

8: Saline-alkali.

9: High concentrations of lime.

X: Coarse fragments on the surface.

Z: Drought (inadequate moisture supplying capacity).

According to this system the capability units of the 15 pedons are presented in Table 2.

Table 2. Capability groups of soils.

Pedon no.	Capability unit non-irrigated	Capability unit irrigated
22	VI e-H	--
116	VI e-U	III e-3
120	VI c-U	III c-3
121	VI e-U	III e-3
124	VI e-U	III e-3
146	VI e-U	III e-3
147	VI e-U	III e-3
148	VII e-U	IV s-3
150	VII e-H	--
163	VI c-H	--
168	VII e-H	--
169	VII e-H	--
170	VII s-H	--
171	VI e-H	--
172	VI c-H	--

METHODS AND PROCEDURES

Field Methods

Seventy-eight soil samples for 15 pedons were sampled by SEAM project* in December, 1976. These 15 sites were selected to represent different soil types that occur on different slopes and at different elevations (2000-3000 meters). The pedons were described in standard notation. The sampling was by horizons, starting with the lowest horizon and working upward to avoid contamination. These samples were taken to the laboratory where they were air-dried and crushed to pass a 2 mm sieve. The percentage of coarse fragments more than 2 mm in diameter was sieved and weighed.

Laboratory Methods

Physical Analysis

Particle size distribution. Particle size distribution was determined by the Soil Testing Laboratory of Utah State University, Logan, Utah. The method used is modified from that given by Kilmer and Alexander (1949). The procedure was as follows: organic matter was removed by treating a 10-gram soil sample wetted with 10 milliliters of water with 5-milliliter increments of 30 percent hydrogen peroxide. The sample was dispersed by shaking with 10 milliliters of sodium

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*SEAM (Surface Environment and Mining). This study was to provide baseline data for the establishment of a resource management scheme for public lands. This particular area was selected because it has coal which might be mined in the future.

hexametaphosphate overnight. The dispersed sample was then washed on a 300-mesh sieve to separate the silt and clay from the sands.

Moisture retention, 1/3 atmosphere percentage. A pressure plate extractor was used according to Richards (1947) for removal of soil moisture at 1/3 atmosphere suction. Soil samples were placed on a ceramic pressure plate and retained on the plate by rubber rings. After complete saturation of soil samples with water, the ceramic plates were mounted in the pressure chamber and air pressure of 1/3 atmosphere applied until cessation of water flow.

Moisture retention, 15 atmosphere percentage. Moisture retention characteristics at 15 atmospheres were also determined by the method designed by Richards (1947). All of the procedure was as described for moisture retention determination at 1/3 atmosphere except for the pressure applied.

Chemical Analysis

The soil chemical analysis was performed at the Soil Testing Laboratory of Utah State University, Logan, Utah. Methods used were as given by U. S. Salinity Laboratory Staff (1954), and soil survey staff (1972).

Saturated soil paste. A soil sample of 250 grams was saturated with distilled water until the soil paste glistened as it reflected light, flowed slightly when the container was tipped, and the paste slid freely and cleanly off the spatula for all soils but those with a high clay content.

Soil water extract. Soil water extract was obtained by the method of U. S. Salinity Laboratory Staff (1954), extracting the saturated soil

paste through a Richards Funnel. A solution of sodium hexametaphosphate was added to the container at a rate of one drop per 25 milliliters of extract in order to avoid precipitation of calcium carbonate on standing.

pH determination of saturated paste. A saturated soil paste was prepared as directed in the method above and allowed to stand for one hour. Readings were determined by placing the electrodes of a pH meter into the paste and obtaining a good contact between the paste and the electrodes.

pH determination of 1:5 paste. A 1:5 paste was prepared as directed by the method, and allowed to stand for one hour. Readings were determined by placing the electrodes of a pH meter in the paste and obtaining a good contact between the paste and the electrodes. A Beckman model H-2 glass electrode pH meter was used.

Electrical conductivity. The total concentration of ionized constituents of the saturation extract was measured by a direct indicating bridge and adjusted to the temperature of the saturation extract (U. S. Salinity Laboratory Staff, 1954). A pipette conductivity cell Model RC-IR conductivity bridge was used.

Cation-exchange capacity. Cation-exchange capacity was determined by the modified procedure of Bower et al. (1952)--saturation with sodium acetate (NaOAc), centrifuging and washing with 99 percent isopropyl alcohol. The results are expressed in me/100 g of oven dry soil.

Extractable cations. An atomic absorption spectrophotometer, model Jarell Ash-800 was used for Na, Mg, Ca and K determinations, after extracting with 1.0 N ammonium acetate at pH 7.0.

Calcium carbonate equivalent. Calcium carbonate equivalent was determined by the method proposed by the U.S. Salinity Laboratory Staff (1954). The procedure involves treating a finely ground sample (less than 60 mesh) with an excess of a 0.5 N HCl. After the carbonates were decomposed, the excess acid was titrated with 0.25 N NaOH.

Base saturation. The procedure used is to divide the sum of NH_4OAC extracted bases by the CEC determined by sodium acetate method No. 5A1, Soil Survey Laboratory Methods (1972).

Gypsum. Method No. 6F1a, titration with versenate as described in the Soil Survey Laboratory Methods (1972), was used. The amount of calcium plus magnesium found in 1:10, 1:50, or 1:100 water extract, less than found in the saturation extract, was considered to be derived from gypsum.

Total nitrogen. Method No. 83-3 (Kjeldahl) as described in Soil Survey Laboratory Methods (1972) was used.

Organic matter. Organic matter was determined using the procedure proposed by Black (1965). Organic carbon was digested by potassium dichromate and concentrated sulfuric acid. After swirling and filtering, the color intensity was read at 610 nm (blue phototube in Spectronic 20) using three organic matter standards (1.4, 2.8, 4.8, % O.M.).

Mineralogical Analysis

X-ray diffraction analysis of clays. Oriented aggregated specimens were obtained by the glass-plate method (Jackson, 1958). The clay fraction less than 0.2 μ, of selected horizons was prepared for x-ray analysis. The procedure involves adding about 20 g of

soil to 150 ml of distilled water and destroying the aggregates by using sodium hexmetaphosphate and ultrasonic waves. The samples were transferred to a 1-liter graduated cylinder and the volume of suspension was brought to 1000 ml. The sample was mixed by electrical shaker. An aliquot of the suspension was extracted with a pipette after 131 minutes of settling and was carefully transferred to a glass slide resting on a level surface. This suspension was allowed to dry completely at room temperature. Samples were run by x-ray diffraction three times. The first run was after putting the samples in a disiccator for four hours. The second run was after saturation with ethylene glycol for one hour in an oven at 50°C. The third time followed heating the samples in an oven at 570°C for one hour. A Siemens x-ray diffraction apparatus with a copper target operated at 35 kv and 16 ma was used.

Differential thermal analysis. The clay fraction of one sample was used. This sample gave a sharp and intense kaolinite peak. The analysis was done following the standard technique of a controlled atmosphere DTA apparatus. Model KAH of Robert Stone Co. was used.

FIELD MORPHOLOGY

The soils of the study area are well-drained and formed from material derived from calcareous sandstone or sandstone mixed with shales. The soils occur on high lake terraces or high mountains on nearly level to steep slopes. Elevations range from 2,000 meters to 3,000 meters. The pedons are described as follows.

Pedon 22

Location: NW Quarter, Sec. 26 T14S R6E

Elevation: 2670 meters

Vegetation: Douglas Fir, Alpine Fir, Wheatgrass

Slope & Aspect: 10% east slope

Horizon	Depth (cm)	Description
A21	0-27	Brown (7.5 YR 5/2) loamy sand, brown to dark brown (7.5 YR 4/2) when moist; single grained; non-sticky, non-plastic, gradual boundary.
A22	27-66	Pinkish-gray (7.5 YR 6/2) loamy sand; brown to dark brown (7.5 YR 4/2) when moist; single grained; non-sticky, non-plastic, clear wavy boundary.
B21t	66-86	Browhish-yellow (10 YR 6/8 silty clay; medium subangular blocky; sticky, plastic; extremely hard dry, clear irregular boundary.
B22	86-110	Grayish-brown (10 YR 5/2), brownish-yellos (10 YR 6/6) clay; strong, medium subangular blocky;

Horizon	Depth (cm)	Description
		sticky, plastic, extremely hard dry; clear, wavy boundary.
B23t	110-131	Brownish-yellow (10 YR 6/6) clay; moderate, medium subangular blocky; sticky, plastic, extremely hard dry; few roots.

Pedon 116

Location: SE Quarter Sec. 26 T14S R8E

Elevation: 2226 meters

Vegetation: Chained Pinon-Juniper Crested Wheatgrass

Slope and Aspect: 6% North slope

Horizon	Depth (cm)	Description
A1	0-8	Brown (10 YR 5/3) fine, sandy loam, dark brown (10 YR 3/3) when moist; loose, single grained.
Bt	8-26	Yellowish brown (10 YR 5/4) loam, dark yellowish brown (10 YR 3/4) when moist; weak, medium subangular blocky; friable, non-sticky, slightly plastic; abundant roots; calcareous here and below.
C1	26-60	Very pale brown (10 YR 7/3) loam, pale brown (10 YR 6/3) when moist; moderate, medium subangular blocky; non-sticky slightly plastic.
R	60	Calcareous sandstone.

Pedon 120

Location: NE Quarter Sec. 23 T14S R8E

Elevation: 2135 meters

Slope and Aspect: 2% North slope

Horizon	Depth (cm)	Description
A1	0-8	Brown (10 YR 5/3) loam, dark brown (10 YR 3/3) when moist; strong, fine platy parting to moderate fine granular; friable, firm, non-sticky, non-plastic; abundant roots; clear wavy boundary.
B21	8-26	Brown (10 YR 5/3) loam, dark brown (10 YR 3/3) when moist; weak, medium prism parting to moderate, medium subangular blocky; firm, friable, slightly sticky, plastic, few roots; clear boundary.
B22	26-46	Yellowish brown (10 YR 5/4) loam, dark yellowish brown (10 YR 3/4) when moist; weak, medium subangular blocky, few cicada casts; firm, friable, non-sticky, plastic; calcareous; gradual boundary.
C1	46-80	Yellowish brown (10 YR 5/4) loam, dark yellowish brown (10 YR 4/4) when moist; few roots
C2	80-100	Same as above with few gravels with $CaCO_3$ on undersides; rock at 100 cm.
R	100	Sandstone bedrock.

Pedon 121

Location: NW Quarter, Sec. 23 T14S R8E

Elevation: 2135 meters

Vegetation: Wild rye, Sagebrush, Rabbitbrush, pinon

Slope and Aspect: 6% West

Horizon	Depth (cm)	Description
A11	0-10	Pale brown (10 YR 6/3) sandy loam, brown to dark brown (10 YR 4/3) when moist; weak, fine platy breaking to moderate, medium granular; non-sticky, slightly plastic; abundant roots; clear wavy boundary.
A12	10-20	Brown (10 YR 5/3) loam, dark brown (10 YR 3/3) when moist; moderate, medium subangular blocky; slightly sticky and slightly plastic; abundant roots; clear wavy boundary.
B1	20-40	Pale brown (10 YR 6/3) heavy loam, brown (10 YR 5/3) when moist; moderate, medium, subangular blocky; slightly sticky, plastic; common roots; gradual boundary.
B2	40-60	Pale brown (10 YR 6/3) clay loam, brown (10 YR 5/3) when moist; moderate, medium, sub-angular blocky; sticky, plastic, gradual boundary.
B3	60-100	Pale brown (10 YR 6/3) clay loam, brown (10 YR 5/3) when moist; moderate, medium, subangular blocky; sticky and plastic; slightly harder than above.

Horizon	Depth (cm)	Description
C1	100-130	Very pale brown (10 YR 7/3) clay loam, brown (10 YR 5/3) when moist.
C2	130	Weathered shale.

Pedon 124

Location: SW Quarter Sec. 25 T14S R8E

Elevation: 2135 meters

Vegetation: Sagebrush, Wildrye

Slope and Aspect: 4% North

Horizon	Depth (cm)	Description
A11	0-6	Grayish brown (10 YR 5/2) sandy loam, very dark grayish brown (10 YR 3/2) when moist; weak, thin, platy, breaking to moderate fine granular; non-sticky, non-plastic, mildly calcareous, few roots; clear wavy boundary.
B1	6-21	Pale red (2.5 YR 6/2) loam, weak red (2.5 YR 4/2) when moist; weak, medium, subangular blocky; non-sticky, slightly plastic, calcareous, extremely hard in place; common roots; clear wavy boundary.
IIC1	21-32	Pale red (2.5 YR 6/2) laom, weak red (2.5 YR 4/2) when moist; moderate; moderate medium subangular blocky; slightly plastic, non-sticky, calcareous; common fine and few medium roots; clear smooth boundary.

Horizon	Depth (cm)	Description
IIC2	32-41	Pale red (2.5 YR 6/2) gravelly sandy loam, weak red (2.5 YR 4/2) when moist; non-sticky, non-plastic, calcareous; few fine roots; clear smooth boundary. Coarse fragment 50% by volume.
IIC3	41-43	Pale red (2.5 YR 6/2) loam, weak red (2.5 YR 4/2) when moist; weak medium subangular blocky; non-sticky, slightly plastic, calcareous; few fine roots; gradual smooth boundary.
IIIC1	53-68	Pale red (2.5 YR 6/2) silt loam, weak red (2.5 YR 4/2) when moist; moderate medium subangular blocky; slightly sticky, plastic, calcareous; few fine roots; gradual smooth boundary, extremely hard in place.
IIIC2	68-97	Pale red (2.5 YR 6/2) silt loam, weak red (2.5 YR 4/2) when moist, moderate, medium subangular blocky; slightly sticky, plastic; clear smooth boundary.
IIIC3	97-127	Pale red (2.5 YR 6/2) loam, weak red (2.5 YR 4/2) when moist; moderate, fine, granular; sticky, plastic; fine sandstone and shale fragments; about 40% by volume.

Pedon 146

Location: SW Quarter Sec. 25 T14S R8E

Elevation: 2112 meters

Vegetation: Sagebrush, Grammagrass

Slop and Aspect: 4% West slope

Horion	Depth (cm)	Description
A1	0-9	Brown (10 YR 5/3) fine sandy loam, dark brown (10 YR 3/3) when moist; weak medium granular; non-sticky, non-plastic, non-calcareous; abundant fine and medium roots; clear smooth boundary.
B1	9-24	Yellowish brown (10 YR 5/4) loam, dark yellowish brown (10 YR 3/4) when moist; weak medium subangular blocky; slightly sticky, slightly plastic, hard, non-calcareous; common medium and fine roots; gradual smooth boundary.
B2t	24-57	Yellowish brown (10 YR 5/4) loam, dark yellowish brown (10 YR 3/4) when moist; moderate medium subangular blocky; plastic, slightly sticky, softer than above, non-calcareous; common fine roots; gradual smooth boundary. Few sandstone fragments. Separated 24-39 cm and 39-57 cm for lab analysis.
B3t	57-73	Light yellowish brown (10 YR 6/4) gravelly loam, dark yellowish brown (10 YR 4/4) when moist; weak medium subangular blocky; plastic, slightly sticky, hard; few fine roots, clear smooth boundary.
C1	73-100	Very pale brown (10 YR 7/3), gravelly loam, brown (10 YR 5/3) when moist; non-plastic,

Horizon	Depth (cm)	Description
		non-sticky, massive, calcareous, 60% calcareous sandstone fragments. Sampled separately for lab analysis.

Pedon 147

Location: SW Quarter Sec. 26, T14S R8E

Elevation: 2105 meters

Vegetation: Sagebrush, Salina wildrye

Slope and Aspect: 3% North

Horizon	Depth (cm)	Description
A1	0-9	Pale brown (10 YR 6/3) fine sandy loam, brown to dark brown (10 YR 4/3) when moist; weak medium platy; non-sticky, non-plastic, non-calcareous; abundent fine and medium roots; clear smooth boundary.
B1	9-18	Brown (10 YR 5/3) loam, dark brown (10 YR 3/3) when moist; moderate medium subangular blocky; slightly sticky, slightly plastic; non-calcareous; abundant fine and medium roots; clear smooth boundary.
B2t	18-33	Yellowish brown (10 YR 5/4) clay loam, dark yellowish brown (10 YR 4/4) when moist; strong fine subangular blocky; sticky, plastic non-calcareous; abundant fine and medium roots; clear wavy boundary.

Horizon	Depth (cm)	Description
C1	33-50	Pale brown (10 YR 6/3) heavy loam, brown (10 YR 5/3) when moist; moderate medium subangular blocky; slightly sticky, plastic; calcareous; common fine and medium roots; diffuse wavy boundary, cicada activity.
C2	50-95	Very pale brown (10 YR 7/3) heavy loam, brown (10 YR 5/3) when moist; moderate medium subangular blocky; slightly sticky, plastic; hard in place, $CaCO_3$ veins; few fine roots; cicada activity.

Pedon 148

Location: NW Quarter Sec. 23, T14S R8E

Elevation: 2135 meters

Vegetation: Pinon, Salina wildrye, Juniper, Indian ricegrass

Slope and Aspect: 8% Northwest

Horizon	Depth (cm)	Description
A11	0-7	Pale brown (10 YR 6/3) sandy loam, brown to dark brown (10 YR 4/3) when moist; weak medium platy; non-sticky, non-plastic; few fine roots; clear smooth boundary.
A12	7-16	Brown (10 YR 5/3) loam, dark brown (10 YR 3/3) when moist; moderate fine granular; slightly sticky, slightly plastic; abundant fine and medium roots; clear smooth boundary.

Horizon	Depth (cm)	Description
B21	16-28	Brown (10 YR 5/3) light clay loam, brown to dark brown (10 YR 4/3) when moist; moderate fine granular; sticky, plastic; common fine and medium roots; gradual smooth boundary.
B22	28-48	Brown (10 YR 5/3) light clay loam, brown to dark brown (10 YR 4/3) when moist; moderate fine granular; common medium roots.
CR	48	Shale with lime coatings.

Pedon 150

Location: NW Quarter Sec. 21, T14S R6E

Elevation: 2806 meters

Vegetation: Aspen and grass

Slope, Aspect: Southwest 50%

Horizon	Depth (cm)	Description
A11	0-8	Gray (10 YR 5/1) sandy loam, black (10 YR 2/1) when moist, strong, fine, granular; non-sticky, non-plastic; abundant medium and fine roots; gradual, smooth boundary; pH 6.2.
A12	8-25	Gray (10 YR 5/1) sandy loam, black (10 YR 2/1) when moist; storng, fine, granular; non-sticky, non-plastic; abundant medium and fine roots; soft, gradual, smooth boundary.
A13	25-45	Gray (10 YR 5/1) sandy loam, black (10 YR 2/1) when moist; strong, fine granular; non-sticky, non-plastic; abundant medium and fine roots; gradual, smooth boundary; 10% sandstone frag-

ments ≤ 2 cm diameter.

A14	45-68	Gray (10 YR 5/1) sandy loam, black (10 YR 2/1) when moist; strong, fine, granular; non-sticky, non-plastic; abundant fine and few medium roots; gradual smooth boundary.
A15	68-98	Gray (10 YR 5/1) sandy loam, very dark gray (10 YR 3/1) when moist; strong fine granular with 5% coarse, highly weathered sandstone chunks; non-sticky, non-plastic; abundant fine and few medium roots; gradual smooth boundary.
A16	98-115	Gray (10 YR 5/1) sandy loam, very dark gray (10 YR 3/1) when moist, strong, fine granular with 50% sandstone chunks ≤ 20 cm; non-sticky, non-plastic, few fine and medium roots.

Pedon 163

Location: NE Corner Sec. 28, R7E T14S

Elevation: 3020 meters

Vegetation: Sagebrush and grass

Slope and Aspect: 8% North

Horizon	Depth (cm)	Description
A11	0-19	Dark grayish brown (10 YR 4/2) silt loam, very dark brown (10 YR 2/2) when moist; weak, medium, subangular blocky; soft, slightly sticky, plastic; common medium roots; gradual, wavy boundary.
A12	19-40	Grayish brown (10 YR 5/2) silty clay loam, very dark grayisy brown (10 YR 3/2) when moist;

Horizon	Depth (cm)	Description
		moderate, medium, subangular blocky; firm, sticky, plastic; common fine, few medium roots; clear, wavy boundary.
B2	40-68	Pale brown (10 YR 6/2) silty clay, brown to dark brown (10 YR 4/3) when moist; strong, medium, subangular blocky; hard, sticky, plastic; few fine roots; clear wavy boundary.
C1	68-85	Pale yellow (5 Y 7/3) silty clay, olive (5 Y 5/3) when moist; strong medium subangular blocky; very hard, sticky, plastic, few fine roots; calcareous.
C2	85-95	Light gray (2.5 Y 7/2) silty clay, grayish brown (2.5 Y 5/2) when moist; moderate, medium subangular blocky; sticky, plastic; very hard, calcareous sandstone flags about 50% by volume.

Pedon 168

Location: SE Quater, Sec. 21, T21 R7E

Elevation: 2852 meters

Vegetation: Aspen and grass

Slope and Aspect: 52% South

Horizon	Depth (cm)	Description
A11	0-15	Dark gray (10 YR 4/1) fine sandy loam, black (10 YR 2/1) when moist; moderate, fine, granular; non-sticky, non-plastic; abundant fine, few medium roots; clear, wavy boundary; 10% fragments (1-4 cm).

Horizon	Depth (cm)	Description
A12	15-34	Dark gray to dark grayish brown (10 YR 4/1.5) sandy loam, very dark gray to very dark grayish brown (10 YR 3/1.5) when moist; moderate fine granular; non-sticky, non-plastic; abundant fine, few medium and coarse roots; gradual, wavy boundary; 10% fragments.
A13	34-67	Dark gray to dark grayish brown (10 YR 4/1.5) sandy loam, very dark gray to very dark grayish brown (10 YR 3/1.5) when moist; moderate, fine granular; non-sticky, non-plastic; abundant fine, few medium and coarse roots; clear, smooth boundary; 10% fragments (1-4 cm).
B2	67-85	Grayish brown (10 YR 5/2) sandy loam, very dark grayish brown (10 YR 3/2) when moist; moderate, fine, granular, non-sticky, non-plastic; common fine, few medium and coarse roots; clear, smooth boundary; 10% fragments (1-4 cm).
IIC1	85-100	Very pale brown (10 YR 7/4) gravelly sandy loam, yellowish brown (10 YR 5/4) when moist; moderate, fine, granular; non-sticky, non-plastic; common fine, few medium roots; clear, smooth boundary; 60% fragments (10 cm).
IIC2	100-110	Very pale brown (10 YR 7/3) loamy sand, brown (10 YR 5/3) when moist; single-grained; non-sticky, non-plastic; 50-60% fragments (10 cm).

Pedon 169

Location: NE Quarter, Sec. 28 T14S R7E

Elevation: 2806 meters

Vegetation: Spruce, Fir, Aspen

Slope and Aspect: 45% North

Horizon	Depth (cm)	Description
A1	0-15	Very pale brown (10 YR 7/3) gravelly loam, yellowish brown (10 YR 5/4) when moist; weak, medium, subangular blocky to moderate fine granular; non-sticky, non-plastic; common fine and few medium and coarse roots; clear, smooth boundary.
B2	15-35	Pale brown (10 YR 6/3) gravelly loam, dark yellowish brown (10 YR 4/4) when moist; weak, medium, subangular blocky; non-sticky, non-plastic; common fine, few medium and coarse roots; clear, smooth boundary; 25% sandstone fragments.
B3	35-60	Very pale brown (10 YR 7/3) loam, yellowish brown (10 YR 5/4) when moist; moderate, medium, subangular blocky; non-sticky, slightly plastic; common fine, medium, and coarse roots; clear, wavy boundary; 40% sandstone.
B4	60-90	Very pale brown (10 YR 7/3) loamy sand, light yellowish brown (10 YR 6/4) when moist; weak, medium, subangular blocky breaking into moderate

Horizon	Depth (cm)	Description
		fine granular; non-sticky, non-plastic; few medium and coarse roots; clear wavy boundary, 40-50% sandstone fragments.
C1	90-115	White (2.5 Y 8/2) gravelly sandy loam, light brownish gray to light yellowish brown (2.5 Y 6/3) when moist; massive; non-sticky, non-plastic; few medium roots; 50% sandstone cobbles and boulders up to 20 cm in diameter.

Pedon 170

Location: SW Quarter Sec. 22 T14S R7E

Elevation: 2910 meters

Vegetation: Grass

Slope and Aspect: 30% West

Horizon	Depth (cm)	Description
A1	0-10	Pale brown (10 YR 6/3) gravelly loam, brown to dark brown (10 YR 4/3) when moist; weak, medium, subangular blocky to weak fine granular; slightly sticky, plastic; abundant fine roots; clear, smooth boundary; 40% coarse fragments.
A2	10-22	Yellowish brown (10 YR 5/4) heavy loam, dark yellowish brown (10 YR 4/4) when moist; moderate, fine, subangular blocky; slightly sticky, plastic; abundant fine roots; gradual, wavy boundary; 50% sandstone fragments (8 cm).

Horizon	Depth (cm)	Description
B1	22-45	Very pale brown (10 YR 7/3) heavy loam, yellowish brown (10 YR 5/4) when moist; strong, fine subangular blocky; slightly sticky, plastic; common fine roots; rocks same as above; clear smooth boundary.
C2	45-60	Very pale brown (10 YR 7/3) silty clay loam, yellowish brown (10 YR 5/4) when moist; massive; sticky, plastic, calcareous; few fine roots; 50-60% sandstone fragments (5 cm) mixed with shale.

Pedon 171

Location: SE Quarter Sec. 28 T14S R7E

Elevation: 2974 meters

Vegetation: Aspen, Western Cone Flower, Spruce, Fir

Slope and Aspect: 18% South

Horizon	Depth (cm)	Description
A11	0-8	Brown (10 YR 5/3) loam, dark brown (10 YR 3/3) when moist; moderate, fine granular; slightly sticky, slightly plastic; abundant fine, few medium roots; clear, smooth boundary.
A12	8-30	Brown (10 YR 5/3) loam, dark brown (10 YR 3/3) when moist; weak, medium, subangular blocky to moderate, fine granular; slightly sticky, plastic; common fine, few medium roots; diffuse, smooth boundary.

Horizon	Depth (cm)	Description
A13	30-52	Brown (10 YR 5/3) loam, dark brown (10 YR 3/3) when moist; weak, medium subangular blocky to moderate, fine granular; slightly sticky, plastic; common fine, few medium roots; diffuse, smooth boundary.
A14	52-78	Brown (10 YR 5/3) loam, dark brown (10 YR 3/3) when moist, moderate, medium subangular blocky; slightly sticky, plastic; few fine, common medium roots; gradual smooth boundary.
B1	78-90	Dark grayish brown (10 YR 4/2) clay loam, very dark grayish brown (10 YR 3/2) when moist; strong, medium subangular blocky; sticky, plastic; few fine and medium roots; abrupt, wavy boundary.
C1	90-115	Pale yellow (2.5 Y 7/4) light clay loam, light olive brown (2.5 Y 5/4) when moist; massive; sticky, plastic; some cobbles (8 cm) of decomposing sandstone, 40% by volume from which soil appears to originate.

Pedon 172

Location: NW Quarter Sec. 27. T14S R73

Elevation: 2806 meters

Vegetation: Grass

Slope and Aspect: 4% Southeast

Horizon	Depth (cm)	Description
A11	0-12	Very dark brown (10 YR 2/2) when moist, loam; moderate fine granular; slightly sticky, plastic; abundant fine and medium roots; gradual smooth boundary.
A12	12-30	Very dark grayish brown (10 YR 3/2) when moist, loam; moderate fine granular; slightly sticky, plastic, abundant fine and medium roots; clear smooth boundary.
C1	30-52	Very dark gray to very dark grayish brown (10 YR 3/1) to (10 YR 3/2) when moist; mixture of sand and clay to form a loam; massive or structureless; slightly sticky, plastic; common medium and fine roots; clear, smooth boundary.
IIC2	52-71	Brown (7.5 YR 5/4) mixture of sand and gravel, dark grayish brown (10 YR 4/2) when moist; clear, smooth boundary; 50% gravels.
IIC3	71-93	Gray (10 YR 5/1) when moist; mixture of coarse sand and gravel; 60% gravels.

RESULTS AND DISCUSSION

The results of analysis of the 15 pedons are listed in Tables 3 through 18, respectively. The discussion is by great group.

Pedon 22

This pedon is Typic Cryoboralf. The epipedon is not dark enough to be molic. Particle-size distribution shows abrupt increase in clay content below 66 cm. The only explanation is that the parent material is sandstone underlained by shales. The pH values range from 4.4 to 5.9 and decrease with depth. Organic carbon is low; values range from 0.3 to 1.8 percent; the higher amounts occur at the surface. Calcium carbonate and gypsum are present in small quantities.

Calculated available water values between 1/3 and 15 bars range from 2.0 to 4 percent in the topsoil and from 7 to 8 percent below the 66 cm depth. This is due to the high clay content below 66 cm.

Cation exchange capacity (CEC) values in the top 66 cm are very low. The values range from 2.5 to 4.5 me/100 g. Values of the CEC in samples deeper than 66 cm are much higher. These values range from 10.5 to 19.0 meq/100 g of soil. Base saturation of the samples ranges from 57 to 100 percent, and the exchangeable complex is dominated by calcium and magnesium.

X-ray diffraction analysis shows kaolinite to be the dominant clay mineral. This soil has very slow permeability, probably because of the high clay content in the soil material below 66 cm depth. This soil on steep slopes may be subject to slippage if slopes are over steepened by cutting.

Table 3. Laboratory analysis for pedon 22.

COLLECTOR'S NUMBER	DEPTH IN cm		PARTICLE SIZE DISTRIBUTION (In mm.) (percent) (1) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %	% >2 mm.	TEXTURAL CLASS
	0-27		---	---	---	---	---	16	8	76	5.5	SL
	27-66		---	---	---	---	---	14	7	79	5.0	LS
	66-86		---	---	---	---	---	25	61	14	0	C
	86-110		---	---	---	---	---	11	86	3	0	C
	110-131		---	---	---	---	---	15	64	21	0	C

pH SATURATED PASTE	1:5	ORGANIC MATTER ORGANIC CARBON %	NITROGEN %	GYPSUM %		TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY MILLIMHOS PER CM @25°C	CaCO3 equivalent %	MOISTURE TENSIONS SATURATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
5.9	6.8	.8	.05			---	.2	<.1	26.2	---	6.1	2.7
5.0	6.1	.5	.02			---	.2	<.1	22.3	---	5.3	2.1
5.2	6.6	.5	.02			---	.4	<.1	50.0	---	17.5	10.4
4.6	6.1	.3	.03			---	.2	<.1	63.8	---	21.5	13.4
4.4	6.0	.3	.02			---	.2	<.1	52.4	---	17.4	10.4

CATION EXCHANGE CAPACITY	EXTRACTABLE CATIONS Ca	Mg	Na	K	SODIUM WATER SOLUBLE Na	EXCH. Na	EXCH. Na %	BASE SATURATION %		DRY BULK DENS. g/cc	MDIST-DENS. (2) MAX. DRY DENS. pcf	OPT. MOIST. %
← MILLIEQUIVALENTS PER 100G →												
4.5	3.4	.5	.4	.1	---	---	---	99		---	---	---
2.5	1.4	.4	.1	.2	---	---	---	75		---	---	---
10.5	4.7	1.5	.2	.2	---	---	---	61		---	---	---
19.0	8.1	2.7	.2	.3	---	---	---	59		---	---	---
13.9	5.8	1.9	.1	.2	---	---	---	57		---	---	---

Table 4. Laboratory analysis for pedon 116.

COLLECTOR'S NUMBER	DEPTH IN Cm		PARTICLE SIZE DISTRIBUTION (In mm.) (percent) (1)									TEXTURAL CLASS
			VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %	% >2 mm.	
	0-8		---	---	---	---	---	10	26	64	3.2	SCL
	8-26		---	---	---	---	---	8	35	57	30.2	SCL
	26-60		---	---	---	---	---	7	39	54	28.8	SCL

pH		ORGANIC MATTER						MOISTURE TENSIONS			
SATURATED PASTE	1:5	ORGANIC CARBON %	NITROGEN %	GYPSUM %		TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY MILLIMHOS PER CM @25°C	CaCO3 equivalent %	SATURATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
7.2	7.8	2.3	.17			---	.6	<.1	43.1	---	11.8	1.8
7.6	8.3	1.6	.19			---	.4	15.8	48.3	---	15.9	1.7
7.6	8.4	1.1	.10			---	.5	32.8	50.4	---	20.3	2.8

CATION EXCHANGE CAPACITY	EXTRACTABLE CATIONS				SODIUM			BASE SATURATION %		DRY BULK DENS. g/cc	MDIST-DENS. (2) MAX. DRY DENS. pcf	MDIST-DENS. (2) OPT. MOIST. %
	Ca	Mg	Na	K	WATER SOLUBLE Na	EXCH. Na	EXCH. Na %					
← MILLIEQUIVALENTS PER 100G						→						
13.5	11.4	1.5	.1	.8	---	---	---	100		---	---	---
14.1	41.3	1.9	.1	.4	---	---	---	---		---	---	---
12.4	40.5	1.6	.2	.1	---	---	---	---		---	---	---

Table 5. Laboratory analysis for pedon 120.

COLLECTOR'S NUMBER	DPTH IN cm		PARTICLE SIZE DISTRIBUTION (In mm.) (percent) (1) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %	% >2 mm.	TEXTURAL CLASS
	0-8		---	---	---	---	---	15	25	60	0	SCL
	8-26		---	---	---	---	---	13	33	54	0	SCL
	26-46		---	---	---	---	---	14	35	51	1.5	SCL
	46-80		---	---	---	---	---	17	35	48	1.7	SCL
	80-100		---	---	---	---	---	16	33	51	1.6	SCL

pH SATURATED PASTE	1:5	ORGANIC MATTER ORGANIC CARBON %	NITROGEN %	GYPSUM %		TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY MILLIMHOS PER CM @25°C	CaCO3 equivalent %	MOISTURE TENSIONS SATURATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
6.7	7.0	---	.11			---	.6	.2	39.4	---	11.5	4.8
7.2	8.1	---	.10			---	.3	.2	44.4	---	11.8	6.8
7.8	8.4	---	.09			---	.3	5.2	43.4	---	13.9	8.1
7.8	8.6	---	.08			---	.4	9.6	38.1	---	16.1	9.3
8.5	8.7	---	.08			---	.3	7.4	44.6	---	14.2	8.0

CATION EXCHANGE CAPACITY	EXTRACTABLE CATIONS Ca	Mg	Na	K	SODIUM WATER SOLUBLE Na	EXCH. Na	EXCH. Na %	BASE SATURATION %		MDIST-DENS. (2) DRY BULK DENS. g/cc	MAX. DRY DENS. pcf	OPT. MOIST. %
← MILLIEQUIVALENTS PER 100G						→						
9.9	6.6	1.5	.1	.7	---	---	---	---		---	---	---
13.0	10.3	2.0	.1	.7	---	---	---	---		---	---	---
12.7	38.3	2.0	.1	.5	---	---	---	---		---	---	---
13.0	40.5	2.5	.1	.4	---	---	---	---		---	---	---
12.4	36.9	5.6	.2	.3	---	---	---	---		---	---	---

Table 6. Laboratory analysis for pedon 121.

COLLECTOR'S NUMBER	DEPTH IN cm		PARTICLE SIZE DISTRIBUTION (In mm.) (percent) (1)									TEXTURAL CLASS
			VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %	% >2 mm.	
	0-10		---	---	---	---	---	8	34	58	0	SCL
	10-20		---	---	---	---	---	1	54	45	12.8	SC
	20-40		---	---	---	---	---	37	20	43	21.5	L
	40-60		---	---	---	---	---	43	21	36	0	L
	60-100		---	---	---	---	---	43	22	35	0	L

pH		ORGANIC MATTER						MOISTURE TENSIONS			
SATURATED PASTE	1:5	ORGANIC CARBON %	NITROGEN %	GYPSUM %		TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY MILLIMHOS PER CM @25°C	CaCO3 equivalent %	SATURATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
8.2	8.5	.7	.08			---	.3	3.2	36.4	---	9.2	5.5
8.1	8.3	1.9	.15			---	.4	3.6	45.2	---	16.3	9.7
8.2	8.4	.3	.09			---	.6	18.2	37.2	---	17.0	8.6
8.2	8.5	.7	.07			---	.5	14.5	36.2	---	17.4	7.9
8.4	8.9	.5	.06			---	.8	14.6	39.4	---	19.2	8.7

	EXTRACTABLE CATIONS				SODIUM					MDIST-DENS. (2)	
CATION EXCHANGE CAPACITY	Ca	Mg	Na	K	WATER SOLUBLE Na	EXCH. Na	EXCH. Na %	BASE SATURATION %		DRY BULK DENS. g/cc	MAX. DRY DENS. pcf	OPT. MOIST. %
← MILLIEQUIVALENTS PER 100G →												
9.0	29.2	1.2	.1	.1	---	---	---	---		---	---	---
15.8	29.4	2.4	.1	1.0	---	---	---	---		---	---	---
11.1	37.5	2.6	.1	.2	---	---	---	---		---	---	---
10.9	36.9	3.9	.1	.2	---	---	---	---		---	---	---
12.0	34.1	9.3	.3	.2	---	---	---	---		---	---	---

Table 7. Laboratory analysis for pedon 124.

COLLECTOR'S NUMBER	DEPTH IN cm		PARTICLE SIZE DISTRIBUTION (in mm.) (percent) (1)								% >2 mm.	TEXTURAL CLASS
			VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %		
	0-6		---	---	---	---	---	30	12	58	5.9	SL
	6-21		---	---	---	---	---	36	16	48	0	L
	21-32		---	---	---	---	---	36	15	49	2.6	L
	32-41		---	---	---	---	---	24	12	64	52.6	SL
	41-53		---	---	---	---	---	35	15	50	1.1	L
	53-68		---	---	---	---	---	55	16	29	0	SiL
	68-97		---	---	---	---	---	57	21	22	0	SiL
	97-127		---	---	---	---	---	30	16	54	50.7	SL

pH		ORGANIC MATTER						MOISTURE TENSIONS			
SATURATED PASTE	1:5	ORGANIC CARBON %	NITROGEN %	GYPSUM %		TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY MILLIMHOS PER CM @25°C	CaCO3 equivalent %	SATURATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
8.2	8.4	.4	.16			---	.8	5.3	40.5	---	11.2	6.9
8.3	8.5	.9	.06			---	.6	10.9	34.3	---	12.1	5.3
8.1	8.7	.6	.05			---	.6	11.9	31.6	---	10.8	4.8
8.2	8.5	.5	.05			---	.6	12.3	28.6	---	8.2	4.3
8.2	8.6	.6	.04			---	.5	12.0	32.5	---	10.8	4.8
8.2	8.6	.6	.05			---	.5	12.0	35.2	---	16.3	6.1
8.2	8.2	.9	.07			---	1.1	12.5	38.2	---	20.0	7.9
7.9	7.8	.7	.05			---	3.4	12.5	29.0	---	14.0	5.8

	EXTRACTABLE CATIONS				SODIUM					MDIST-DENS. (2)	
CATION EXCHANGE CAPACITY	Ca	Mg	Na	K	WATER SOLUBLE Na	EXCH. Na	EXCH. Na %	BASE SATURATION %		DRY BULK DENS. g/cc	MAX. DRY DENS. pcf	OPT. MOIST. %
←	MILLIEQUIVALENTS PER 100G					→						
9.5	12.7	1.4	.1	1.1	---	---	---	---		---	---	---
9.8	27.8	1.7	.1	.4	---	---	---	---		---	---	---
9.2	27.3	1.6	.1	.3	---	---	---	---		---	---	---
7.0	22.3	1.4	.1	.2	---	---	---	---		---	---	---
9.2	25.9	2.1	.1	.3	---	---	---	---		---	---	---
10.4	29.7	3.9	.1	.3	---	---	---	---		---	---	---
14.1	31.9	5.4	.2	.3	---	---	---	---		---	---	---
8.9	40.8	2.6	.4	.3	---	---	---	---		---	---	---

Table 8. Laboratory analysis for pedon 146.

COLLECTOR'S NUMBER	DEPTH IN cm		PARTICLE SIZE DISTRIBUTION (In mm.) (percent) (1)									TEXTURAL CLASS
			VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %	% >2 mm.	
	0-9		--	--	--	--	--	30	10	60	2.2	SL
	9-24		--	--	--	--	--	31	15	54	3.4	SL
	24-39		--	--	--	--	--	29	19	52	2.7	SL
	39-57		--	--	--	--	--	30	18	52	8.2	SL
	57-72		--	--	--	--	--	28	19	53	5.1	SL
	72-100		--	--	--	--	--	30	16	54	62.5	SL

pH		ORGANIC MATTER						MOISTURE TENSIONS			
SATURATED PASTE	1:5	ORGANIC CARBON %	NITROGEN %	GYPSUM %	TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY MILLIMHOS PER CM @25°C	$CaCO_3$ equivalent %	SATURATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
7.1	7.4	1.3	.10		--	.5	.1	36.0	--	11.8	4.6
7.3	7.6	1.0	.10		--	.3	.2	36.0	--	11.8	5.4
7.6	7.7	.7	.08		--	.3	.1	34.9	--	12.7	6.5
7.6	7.4	.7	.07		--	.3	.1	33.8	--	12.7	6.3
7.8	7.7	.7	.09		--	.3	<.1	34.9	--	13.6	6.5
8.2	8.4	.8	.10		--	.5	22.8	47.0	--	18.2	8.5

	EXTRACTABLE CATIONS				SODIUM					MDIST-DENS. (2)	
CATION EXCHANGE CAPACITY	Ca	Mg	Na	K	WATER SOLUBLE Na	EXCH. Na	EXCH. Na %	BASE SATURATION %		DRY BULK DENS. g/cc	MAX. DRY DENS. pcf	OPT. MOIST. %
←	MILLIEQUIVALENTS PER 100G					→						
9.6	6.3	1.5	.1	.6	--	--	--	--		--	--	--
12.8	8.6	2.1	.1	.6	--	--	--	--		--	--	--
12.0	9.4	2.5	.1	.6	--	--	--	--		--	--	--
12.0	9.1	2.5	.1	.5	--	--	--	--		--	--	--
12.0	9.4	2.7	.1	.4	--	--	--	100		--	--	--
9.8	39.4	3.7	.1	.1	--	--	--	--		--		

Table 9. Laboratory analysis for pedon 147.

COLLECTOR'S NUMBER	DEPTH IN CM		PARTICLE SIZE DISTRIBUTION (In mm.) (percent) (1)									TEXTURAL CLASS
			VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %	% >2 mm.	
	0–9		—	—	—	—	—	27	11	62	<1.0	SL
	9–18		—	—	—	—	—	32	22	46	0	L
	18–33		—	—	—	—	—	35	27	38	1.1	L
	33–50		—	—	—	—	—	37	22	41	7.9	L
	50–72		—	—	—	—	—	36	22	42	4.4	L
	72–95		—	—	—	—	—	41	22	37	<1.0	L

pH		ORGANIC MATTER						MOISTURE TENSIONS			
SATURATED PASTE	1:5	ORGANIC CARBON %	NITROGEN %	GYPSUM %		TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY MILLIMHOS PER CM @25°C	CaCO3 equivalent %	SATURATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
7.5	7.7	.9	.08			—	.6	.1	35.9	—	8.3	4.1
7.3	7.5	1.0	.11			—	.4	<.1	36.1	—	14.3	8.0
7.6	7.9	.9	.10			—	.5	<.1	45.4	—	20.9	11.9
8.1	8.5	.7	.08			—	.5	19.8	42.1	—	21.5	10.6
8.1	8.5	.5	.06			—	.4	18.5	39.1	—	19.8	9.4
8.2	8.7	.3	.04			—	.4	18.0	37.0	—	19.7	9.1

	EXTRACTABLE CATIONS				SODIUM					MDIST-DENS. (2)	
CATION EXCHANGE CAPACITY	Ca	Mg	Na	K	WATER SOLUBLE Na	EXCH. Na	EXCH. Na %	BASE SATURATION %		DRY BULK DENS. g/cc	MAX. DRY DENS. pcf	OPT. MOIST. %
←	MILLIEQUIVALENTS PER 100G					→						
8.3	6.7	2.1	.1	.8	—	—	—	114		—	—	—
15.9	11.7	3.8	.1	.7	—	—	—	100		—	—	—
23.4	17.2	4.8	.2	.5	—	—	—	100		—	—	—
14.6	42.2	3.8	.2	.3	—	—	—	—		—	—	—
12.0	39.2	3.7	.3	.2	—	—	—	—		—	—	—
12.8	39.1	6.3	.2	.2	—	—	—	—		—	—	—

Table 10. Laboratory analysis for pedon 148.

COLLECTOR'S NUMBER	DEPTH IN cm		PARTICLE SIZE DISTRIBUTION (In mm.) (percent) (1)								% >2 mm.	TEXTURAL CLASS
			VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %		
	0.7		---	---	---	---	---	26	16	58	47.3	SL
	7-16		---	---	---	---	---	34	24	42	25.2	L
	16-28		---	---	---	---	---	35	22	43	31.8	L
	28-48		---	---	---	---	---	35	22	43	30.5	L

pH		ORGANIC MATTER				TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY MILLIMHOS PER CM @25°C	CaCO3 equivalent %	MOISTURE TENSIONS			
SATURATED PASTE	1:5	ORGANIC CARBON %	NITROGEN %	GYPSUM %					SATURATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
7.8	8.3	1.2	.11			---	1.0	9.5	30.0	---	12.7	5.8
7.8	8.2	2.2	.17			---	.9	11.0	51.6	---	20.2	11.3
7.9	8.4	1.3	.10			---	.6	12.0	41.5	---	19.0	8.8
8.0	8.4	1.0	.08			---	.5	12.0	40.2	---	17.9	23.5

	EXTRACTABLE CATIONS				SODIUM						MDIST-DENS. (2)	
CATION EXCHANGE CAPACITY	Ca	Mg	Na	K	WATER SOLUBLE Na	EXCH. Na →	EXCH. Na %	BASE SATURATION %		DRY BULK DENS. g/cc	MAX. DRY DENS. pcf	OPT. MOIST. %
← MILLIEQUIVALENTS PER 100G												
9.8	31.9	1.4	.1	.4	---	---	---	---		---	---	---
19.0	43.1	2.5	.1	.6	---	---	---	---		---	---	---
15.9	40.6	3.4	.1	.3	---	---	---	---		---	---	---
15.4	37.3	5.3	.1	.3	---	---	---	---		---	---	---

Table 11 Laboratory analysis for pedon 150.

COLLECTOR'S NUMBER	DEPTH IN cm		PARTICLE SIZE DISTRIBUTION (in mm.) (percent) (1)									TEXTURAL CLASS
			VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %	% >2 mm.	
	0–8		—	—	—	—	—	16	12	72	6.2	SL
	8–25		—	—	—	—	—	15	13	72	4.7	SL
	25–45		—	—	—	—	—	12	13	75	6.5	SL
	45–68		—	—	—	—	—	12	13	75	5.8	SL
	68–98		—	—	—	—	—	13	13	74	7.1	SL
	98–115		—	—	—	—	—	12	13	75	3.9	SL

pH		ORGANIC MATTER				ELECTRICAL CONDUCTIVITY		MOISTURE TENSIONS			
SATURATED PASTE	1:5	ORGANIC CARBON %	NITROGEN %	GYPSUM %	TOTAL SOLUBLE SALTS %	MILLIMHOS PER CM @25°C	CaCO3 equivalent %	SATURATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
5.5	7.8	.6	.22		—	1.4	.2	39.3	—	14.1	7.2
5.8	7.9	.5	.19		—	.4	.3	36.6	—	12.2	7.2
6.1	7.9	.4	.12		—	.4	<.1	33.5	—	10.0	5.7
6.0	7.7	1.5	.12		—	.3	.1	31.5	—	10.9	5.6
5.7	7.7	1.4	.11		—	.5	.1	33.1	—	9.6	5.5
6.0	7.8	1.2	.09		—	.4	.1	26.6	—	9.3	4.4

CATION EXCHANGE CAPACITY	EXTRACTABLE CATIONS				SODIUM			BASE SATURATION %		MDIST-DENS. (2)		
	Ca	Mg	Na	K	WATER SOLUBLE Na	EXCH. Na	EXCH. Na %			DRY BULK DENS. g/cc	MAX. DRY DENS. pcf	OPT. MOIST. %
←	MILLIEQUIVALENTS PER 100G					→						
12.2	9.2	1.2	.1	.5	—	—	—	84		—	—	—
12.2	6.7	.9	.1	.4	—	—	—	70		—	—	—
9.0	6.9	.8	.1	.3	—	—	—	88		—	—	—
8.7	7.5	.9	.1	.2	—	—	—	98		—	—	—
8.8	5.9	.6	.1	.2	—	—	—	76		—	—	—
7.3	5.0	.6	.1	.2	—	—	—	79		—	—	—

Table 12. Laboratory analysis for pedon 163.

COLLECTOR'S NUMBER	DEPTH IN cm		PARTICLE SIZE DISTRIBUTION (In mm.) (percent) (1) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %	% >2 mm.	TEXTURAL CLASS
	0-19		---	---	---	---	---	41	24	35	0	L
	19-40		---	---	---	---	---	46	38	16	1.5	SiCl
	40-68		---	---	---	---	---	46	42	12	4.0	SiC
	68-85		---	---	---	---	---	46	44	10	4.0	SiC
	85-95		---	---	---	---	---	51	44	5	4.0	SiC

pH		ORGANIC MATTER						MOISTURE TENSIONS			
SATURATED PASTE	1:5	ORGANIC CARBON %	NITROGEN %	GYPSUM %	TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY MILLIMHOS PER CM @25°C	$CaCO_3$ equivalent %	SATURATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
6.2	6.9	1.0	.42		---	.5	.1	74.4	---	33.3	21.4
6.6	7.1	2.2	.21		---	.4	.1	51.0	---	28.2	17.8
6.8	7.3	.7	.09		---	.3	.1	48.3	---	28.1	15.7
7.6	8.4	.6	.08		---	.4	21.4	48.3	---	25.6	14.2
7.7	8.3	.5	.06		---	.4	17.0	46.9	---	24.9	13.7

CATION EXCHANGE CAPACITY	EXTRACTABLE CATIONS				SODIUM			BASE SATURATION %		MDIST-DENS. DRY BULK DENS. g/cc	MAX. DRY DENS. (2) pcf	OPT. MOIST. %
	Ca	Mg	Na	K	WATER SOLUBLE Na	EXCH. Na	EXCH. Na %					
← MILLIEQUIVALENTS PER 100G →												
27.2	21.9	3.0	.1	1.4	---	---	---	96		---	---	---
25.5	18.8	2.3	.1	.8	---	---	---	85		---	---	---
24.5	21.7	2.0	.1	.4	---	---	---	98		---	---	---
21.2	45.0	1.9	.2	.3	---	---	---	---		---	---	---
20.1	42.9	1.6	.2	.3	---	---	---	---		---	---	---

Table 13. Laboratory analysis for pedon 168.

COLLECTOR'S NUMBER	DEPTH IN cm		PARTICLE SIZE DISTRIBUTION (in mm.) (percent) (1)								% >2 mm.	TEXTURAL CLASS
			VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %		
	0–15		---	---	---	---	---	15	7	78	22.0	LS
	15–34		---	---	---	---	---	16	9	75	17.6	SL
	34–67		---	---	---	---	---	13	9	78	13.7	SL
	67–85		---	---	---	---	---	15	9	76	13.9	SL
	85–100		---	---	---	---	---	18	8	74	16.9	SL

pH		ORGANIC MATTER						MOISTURE TENSIONS			
SATURATED PASTE	1:5	ORGANIC CARBON %	NITROGEN %	GYPSUM %		TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY MILLIMHOS PER CM @25°C	$CaCO_3$ equivalent %	SATURATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
6.3	7.1	.8	.28			---	.5	.4	53.8	---	16.4	12.5
6.3	6.8	.5	.19			---	.2	.1	61.1	---	12.6	8.6
6.3	6.9	.4	.14			---	.2	.1	76.3	---	11.0	5.9
6.3	6.9	.3	.11			---	.2	.1	36.4	---	9.0	4.5
6.6	6.9	.4	.03			---	.2	.1	26.7	---	6.8	1.8

CATION EXCHANGE CAPACITY	EXTRACTABLE CATIONS				SODIUM			BASE SATURATION %		DRY BULK DENS. g/cc	MDIST-DENS. (2) MAX. DRY DENS. pcf	OPT. MOIST. %
	Ca	Mg	Na	K	WATER SOLUBLE Na	EXCH. Na	EXCH. Na %					
← MILLIEQUIVALENTS PER 100G						→						
14.2	11.9	1.3	.1	.4	---	---	---	100		---	---	---
13.0	9.4	.8	.1	.3	---	---	---	80		---	---	---
9.3	7.8	.7	.1	.2	---	---	---	92		---	---	---
7.3	5.9	.6	.1	.2	---	---	---	91		---	---	---
2.5	1.7	.3	.1	.1	---	---	---	83		---	---	---

Table 14. Laboratory analysis for pedon 169.

COLLECTOR'S NUMBER	DEPTH IN cm		PARTICLE SIZE DISTRIBUTION (in mm.) (percent) (1)									TEXTURAL CLASS
			VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %	% >2 mm.	
	0-15		---	---	---	---	---	26	8	66	21.9	SL
	15-35		---	---	---	---	---	29	9	62	22.9	SL
	35-60		---	---	---	---	---	28	9	63	26.2	SL
	60-90		---	---	---	---	---	15	6	79	28.9	SL
	90-115		---	---	---	---	---	35	11	54	<1.0	SL

pH		ORGANIC MATTER				ELECTRICAL CONDUCTIVITY		MOISTURE TENSIONS			
SATURATED PASTE	1:5	ORGANIC CARBON %	NITROGEN %	GYPSUM %	TOTAL SOLUBLE SALTS %	MILLIMHOS PER CM @25°C	CaCO3 equivalent %	SATURATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
6.0	6.5	.8	.03		---	.2	.1	34.5	---	9.5	3.1
5.6	6.0	.7	.03		---	.2	.1	28.1	---	10.3	2.8
5.9	6.6	.5	.02		---	.2	.1	27.1	---	11.0	2.6
5.9	6.3	.4	.01		---	.2	<.1	24.7	---	5.8	1.5
6.5	6.7	.4	.02		---	.2	<.1	25.9	---	12.5	2.3

CATION EXCHANGE CAPACITY	EXTRACTABLE CATIONS				SODIUM			BASE SATURATION %		MDIST-DENS. (2)	
	Ca	Mg	Na	K	WATER SOLUBLE Na	EXCH. Na	EXCH. Na %		DRY BULK DENS. g/cc	MAX. DRY DENS. pcf	OPT. MOIST. %
←	MILLIEQUIVALENTS PER 100G					→					
3.9	2.3	.4	.1	.1	---	---	---	73	---	---	---
3.5	1.9	.5	.1	.2	---	---	---	76	---	---	---
4.5	2.4	.4	.1	.1	---	---	---	64	---	---	---
1.4	.8	.2	.1	.1	---	---	---	78	---	---	---
2.8	1.5	.4	.1	.1	---	---	---	71	---	---	---

Table 15. Laboratory analysis for pedon 170.

COLLECTOR'S NUMBER	DEPTH IN Cm		PARTICLE SIZE DISTRIBUTION (In mm.) (percent) (1) VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %	% >2 mm.	TEXTURAL CLASS
	0-10		---	---	---	---	---	33	21	46	20.0	L
	10-22		---	---	---	---	---	30	22	48	17.4	L
	22-45		---	---	---	---	---	34	25	41	14.4	L
	45-90		---	---	---	---	---	46	26	28	47.8	L

pH		ORGANIC MATTER						MOISTURE TENSIONS			
SATURATED PASTE	1:1	ORGANIC CARBON %	NITROGEN %	GYPSUM %		TOTAL SOLUBLE SALTS %	ELECTRICAL CONDUCTIVITY MILLIMHOS PER CM @25°C	CaCO3 equivalent %	SATURATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
7.0	7.1	3.7	.29			---	.7	.1	53.3	---	22.3	10.4
7.2	7.1	.6	.07			---	.5	.1	33.4	---	14.2	6.4
7.6	8.1	.4	.05			---	.4	.2	36.7	---	16.8	6.9
7.9	8.1	.5	.05			---	.6	.3	41.4	---	20.4	8.1

	EXTRACTABLE CATIONS				SODIUM					MOIST-DENS. (2)	
CATION EXCHANGE CAPACITY	Ca	Mg	Na	K	WATER SOLUBLE Na	EXCH. Na	EXCH. Na %	BASE SATURATION %	DRY BULK DENS. g/cc	MAX. DRY DENS. pcf	OPT. MOIST. %
← MILLIEQUIVALENTS PER 100G →											
14.8	11.0	2.1	.1	1.6	---	---	---	97	---	---	---
6.3	5.2	1.3	.1	.9	---	---	---	---	---	---	---
8.7	8.3	1.6	.1	.2	---	---	---	---	---	---	---
9.8	14.2	2.3	.2	.2	---	---	---	---	---	---	---

Table 16. Laboratory analysis for pedon 171.

COLLECTOR'S NUMBER	DEPTH IN Cm		PARTICLE SIZE DISTRIBUTION (In mm.) (percent) (1)									TEXTURAL CLASS
			VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %	% >2 mm.	
	0-8		---	---	---	---	---	25	16	59	3.4	SL
	8-30		---	---	---	---	---	26	16	58	<1.0	SL
	30-52		---	---	---	---	---	25	17	58	2.9	SL
	52-78		---	---	---	---	---	24	17	59	<1.0	SL
	78-90		---	---	---	---	---	26	23	51	<1.0	SCL
	90-115		---	---	---	---	---	20	19	61	9.3	SL

pH		ORGANIC MATTER				ELECTRICAL CONDUCTIVITY		MOISTURE TENSIONS			
SATURATED PASTE	1:5	ORGANIC CARBON %	NITROGEN %	GYPSUM %	TOTAL SOLUBLE SALTS %	MILLIMHOS PER CM @25°C	CaCO3 equivalent %	SATURATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
6.2	6.9	2.4	.22		---	.3	.1	46.8	---	17.6	8.5
6.2	6.8	1.8	.16		---	.3	.1	43.1	---	15.6	7.5
6.4	6.9	1.4	.12		---	.2	.1	37.0	---	15.2	6.9
6.5	7.0	1.0	.09		---	.2	.1	34.0	---	14.2	6.2
7.0	7.6	1.8	.18		---	.3	.1	48.8	---	22.1	12.3
7.8	8.0	.5	.05		---	.4	.9	34.8	---	14.7	5.8

CATION EXCHANGE CAPACITY	EXTRACTABLE CATIONS				SODIUM			BASE SATURATION %		DRY BULK DENS. g/cc	MDIST-DENS. (2) MAX. DRY DENS. pcf	OPT. MOIST. %
	Ca	Mg	Na	K	WATER SOLUBLE Na	EXCH. Na	EXCH. Na %					
← MILLIEQUIVALENTS PER 100G						→						
13.8	8.0	1.0	.1	.9	---	---	---	71		---	---	---
12.6	7.9	.7	.1	.4	---	---	---	72		---	---	---
11.3	7.6	.7	.1	.3	---	---	---	76		---	---	---
10.9	7.7	.7	.1	.2	---	---	---	79		---	---	---
21.2	17.3	1.1	.1	.3	---	---	---	89		---	---	---
8.6	11.3	.6	.1	.1	---	---	---	---		---	---	---

Table 17. Laboratory analysis for pedon 172.

COLLECTOR'S NUMBER	DEPTH IN cm		PARTICLE SIZE DISTRIBUTION (In mm.) (percent) (1)								%	TEXTURAL CLASS
			VERY COARSE SAND 2-1	COARSE SAND 1-0.5	MEDIUM SAND 0.5-0.25	FINE SAND 0.25-0.10	VERY FINE SAND 0.10-0.05	SILT 0.05-0.002	CLAY <0.002	SAND <2 mm %	>2 mm.	
	0-12		---	---	---	---	---	34	10	56	0	SL
	12-30		---	---	---	---	---	34	10	56	0	SL
	30-52		---	---	---	---	---	25	16	59	3.4	SL
	52-71		---	---	---	---	---	---	---	---	65.7	---
	71-93		---	---	---	---	---	---	---	---	72.2	---

pH		ORGANIC MATTER				ELECTRICAL CONDUC-TIVITY		MOISTURE TENSIONS			
SATURATED PASTE	1:5	ORGANIC CARBON %	NITROGEN %	GYPSUM %	TOTAL SOLUBLE SALTS %	MILLIMHOS PER CM @25°C	CaCO3 equivalent %	SATU-RATION %	1/10 ATMOS. %	1/3 ATMOS. %	15 ATMOS. %
6.8	6.6	7.3	.40		---	.5	<.1	87.6	---	31.5	22.0
7.0	6.6	4.8	.32		---	.4	<.1	72.7	---	29.0	15.2
6.2	6.2	1.2	.09		---	.3	.1	37.7	---	16.0	6.8
6.8	6.5	.4	.02		---	.3	<.1	25.1	---	4.3	2.1
5.5	5.8	.3	.02		---	.2	.1	28.0	---	7.6	3.7

CATION EXCHANGE CAPACITY	EXTRACTABLE CATIONS				SODIUM			BASE SATU-RATION %		DRY BULK DENS. g/cc	MDIST-DENS. (2) MAX. DRY DENS. pcf	OPT. MOIST. %
	Ca	Mg	Na	K	WATER SOLUBLE Na	EXCH. Na	EXCH. Na %					
← MILLIEQUIVALENTS PER 100G →												
23.4	18.6	3.1	.1	.7	---	---	---	94		---	---	---
25.5	16.7	2.1	.1	.1	---	---	---	73		---	---	---
10.9	6.5	1.1	.1	.1	---	---	---	---		---	---	---
2.8	2.3	.4	.1	0	---	---	---	100		---	---	---
4.0	2.5	.4	.1	.1	---	---	---	---		---	---	---

Table 18*. Estimated mineral abundance in the clay fraction of the 15 pedons.

Pedon no.	Horizon	Depth (cm)	Kaolinite	Illite	Quartz	Montmorillonite
22	B21t	66-86	66	26	8	--
116	Bt	8-26	62	31	7	--
120	B22	26-46	57	43	--	--
121	B1	20-40	71	21	8	--
	B2	40-60	62	29	9	--
124	IIC1	21-32	54	37	9	--
	IIIC2	68-97	57	36	7	--
146	B2t	24-39	41	44	15	--
	B2t	39-57	47	47	6	--
147	B2t	18-33	57	28	15	--
	C1	33-50	75	25	--	--
148	B21	16-28	58	27	15	--
150	A14	45-68	87	8	5	--
163	B2	40-68	56	31	13	--
168	B2	67-85	84	10	6	--
169	B3	35-60	83	11	6	--
170	B1	22-45	80	16	4	--
171	A14	52-78	68	17	15	--
172	C1	30-52	74	26	--	--

*Values are calculated as follows: Individual peak area divided by summation of all peak areas times 100 to give the percentage the peak is of the total peak area.

Pedons 116, 121, 124, 146, 147

These pedons are classified as Borollic Haplargids. They occur on nearly level and gentle slopes. Particle-size distribution has an increase in clay content with depth, with maximum clay contents in the argillic horizons. All these pedons have high amounts of sand and silt and most of these pedons have layers with appreciable amounts of gravel. The pH values range from 7.2 to 8.4 and increase with depth. Organic carbon values range from 0.4 to 0.8 percent in the subsurface horizons to values of 0.9 to 2.3 percent in the surface layers. Calcium carbonate values are low in the surface layers and abruptly increase below 20 to 30 cm. This suggests a calcareous parent material. Gypsum and soluble cations are present in small quantities. The calculated available water values range from 4 to 10 percent.

CEC values range from 8 to 13 me/100 g in the surface layers to 10 to 23 me/100 g in the argillic horizons. Base saturation values in all pedons are 100 percent. The cation exchange complex is dominated by calcium and magnesium.

EC values in most samples of all pedons are low. The relatively high EC value below 97 cm in pedon 124 suggests the parent material of this pedon is sandstone mixed with saline shale.

X-ray diffraction analysis shows kaolinite and illite to be the dominant clay minerals. The permeabilities range from moderate to moderately rapid. Slow to moderately slow permeability in pedon 116 is due to the high clay content in the subsoil material.

Pedon 120

This pedon is classified as Aridic Haploboroll. This soil is deep and occurs on nearly level slopes. Particle-size distribution shows the clay content range from 25 to 35 percent, with appricable amounts of sand and silt. The pH values range from 6.7 to 8.5 and increase with depth. Organic carbon values range from 0.7 to 0.8 in the subsoil to 0.9 to 1.2 percent in the mollic epipedon. EC values are low, ranging from 0.3 to 0.6 mmhos/cm. The calcium carbonate equivalent is 0.2 percent in the mollic epipedon and ranges from 5.2 to 7.4 percent in the subsoil. The carbonate increase with depth suggests that the parent material of this pedon is calcareous sandstone. The calculated available water values range from 4 to 6 percent.

CEC values range from 9.9 to 13.0 me/100 g. Calcium and magnesium are the dominant cations on the exchangeable complex. X-ray diffraction analysis shows kaolinite and illite to be the dominant clay minerals. This soil has only moderate permeability. This may be due to the relatively high clay content in the soil material below 26 cm.

Pedon 148

This pedon is classified as Ustic Torriorthent. This soil is moderately deep and occurs on an 8 percent slope. Particle-size distribution shows high silt and sand values, with appreciable amounts of gravel. Clay content is 16 percent in the surface layer and 22 to 24 percent in the subsoil. The pH values range from 7.8 to 8.0 and increase with depth. The organic matter is relatively high; values of organic carbon range from 1.0 to 2.2 percent. EC values range from 0.5 to 1.0 mmhos/cm and decrease with depth. Calcium carbonate equivalent is

present in appreciable amounts. Values of $CaCO_3$ range from 9.5 to 12.0 percent and increase with depth. This suggests a calcareous parent material. Gypsum and soluble cations are present in small quantities. The calculated available water values range from 5 to 11 percent.

CEC values range from 9.8 me/100 g to 15 to 19 me/100 g in the subsoil. Calcium and magnesium are the dominant cations on the exchangeable complex. This soil has low water supplying capacity. This is because of the low clay content and shallow depth. This pedon has moderate to moderately rapid permeability. X-ray diffraction analysis shows kaolinite and illite to be the dominant clay minerals.

Pedons 150, 168, 171

These pedons are classified as Pachic Cryoborolls. These soils are deep and have thick dark surface layers, i.e., mollic epipedons, which have high contents of organic matter. These soils occur on steep slopes at high elevations. Particle-size distribution indicates a low clay content and high percentage of sands. The distribution of sand, silt and clay is uniform through the profile. The pH values range from 5.5 to 7.8 and increase with depth. EC values are low, with values from 0.2 to 1.4 mmhos/cm. Calcium carbonate, gypsum, and soluble cations are present in small quantities. The calculated available water values range from 4 to 7 percent.

CEC values range from 12 to 20 me/100 g in the mollic epipedon and from 7 to 9 me/100 g in the subsurface horizons. Base saturation values range from 70 to 100 percent. Calcium and magnesium are the dominant cations on the exchange complex. X-ray diffraction analysis shows

kaolinite to be the dominant clay mineral. The permeability ranges from moderate to moderately rapid.

Pedons 163

This pedon is classified as Typic Cryoboroll. This soil is deep and occurs on an 8 percent slope. The soil has a dark surface horizon to 40 cm depth. Particle-size distribution shows an increase in clay content with depth; values of clay content range from 24 to 38 percent in the mollic epipedon to 42 to 44 percent in the subsoil. The pH values range from 6.2 to 7.7 and increase with depth. Organic carbon values range from 1.0 to 2.2 percent in the mollic epipedon to 0.5 to 0.7 percent in the subsoil. EC values range from 0.3 to 0.5 mmhos/cm. Calcium carbonate is very low in the mollic epipedon and increases abruptly below 40 cm. This suggests a calcareous parent material. Gypsum and soluble cations are present in small quantities. The calculated available water values range from 11 to 13 percent.

The CEC values are relatively high, ranging from 20.0 to 27.2 me/100 g. The relatively high CEC values may be due to the high clay and organic matter content in this pedon. Base saturation values range from 85 to 100 percent. Calcium and magnesium are dominant cations on the exchangeable complex.

X-ray diffraction analysis shows kaolinite and illite to be the dominant clay minerals. This soil has slow permeability because of the high clay content in the soil material below 40 cm.

Pedons 169 and 170

These pedons are classified as Typic Cryochrepts. These soils are moderately deep to deep and occur on steep slopes. Particle-size

distribtuion shows high values of silt and sand, with appreciable amounts of cobbles and gravel, throughout the pedons. Clay content is low in pedon 169 and relatively high in pedon 170. The pH values range from 5.6 to 6.5 in pedon 169, and from 7.0 to 7.9 in pedon 170. Organic matter is low in both pedons except in the surface layer of pedon 170. EC, calcium carbonate, gypsum, and soluble cations in both pedons are very low. The calculated available water values range from 4 to 9 percent in pedon 169 and from 8 to 12 percent in pedon 170.

Both pedons have low CEC values. Values range from 6 to 20 me/100 g. Relatively higher CEC values in the surface layer of pedon 170 are due to the high content of organic matter in this horizon. Base saturation values range from 64 to 97 percent. Extractable cations are very low and calcium and magnesium are the dominant cations on the exchangeable complex. These soils have moderate to moderately rapid permeability. Water supplying capacity is low. This may be attributed to the shallow depth and low clay content.

X-ray diffraction analysis shows kaolinite to be the dominant clay mineral.

Pedon 172

Pedon 172 is classified as Cumulic Cryoboroll. This soil is moderately deep and occurs on gentle slopes. It has a thick mollic epipedon with high content of organic matter. Values of organic carbon range from 1.2 to 7.3 percent in the mollic epipedon to 0.3 to 0.4 percent in the subsoil. The pH values range from 5.5 to 6.8. EC values are very low. Calcium carbonate, gypsum, extractable cations

and soluble cations are present in small quantities. The calculated available water values range from 9 to 14 percent in the mollic epipedon, to 2 to 4 percent in the subsoil.

CEC values are relatively high in the mollic epipedon, and very low in the soil material below 71 cm depth. High CEC values in the topsoil are due to the high content of organic matter. CEC values range from 10 to 23 me/100 g in the mollic epipedon to 2 to 4 me/100 g in the soil material below 52 cm deep. This soil has moderate permeability and low water supplying capacity. This may be due to the low clay content.

X-ray diffraction analysis shows kaolinite to be the dominant clay mineral.

CLASSIFICATION OF THE SOILS

Soils are classified so that we can more easily remember their significant characteristics. Classification enables us to assemble knowledge about the soils, to see their relationship to one another and to the whole environment, and to develop principles that help us to understand their behavior and their response to manipulation. First through classification and then through use of soil maps, we can apply our knowledge of soils to specific fields and other tracts of land.

The narrow categories of classifications, such as those used in detailed soil surveys, allow us to organize and apply knowledge about soils in managing farms, fields, and woodlands; and in many other ways soils are placed in broad classes to facilitate study and comparison in large areas such as countries and continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 and later revised in 1949. The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965.

The current system of classification has six categories. Beginning with the broadest, these categories are order, suborder, great group subgroup, family, and series. In this system, the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however, so that the soils of similar genesis, or mode of origin, are grouped.

According to the currently used system of classification the Manti-LaSal 15 pedons are presented in Table 19.

Table 19. Soil classification of the fifteen pedons.

Pedon No.	Soil Classification		
	Family	Subgroup	Order
22	Very fine, mixed	Typic Cryoboralf	Alfisol
116	Clayey-skeletal, mixed	Borollic Haplargid	Aridisol
120	Fine loamy, mixed	Aridic Haploboroll	Mollisol
121	Fine, mixed	Borollic Haplargid	Aridisol
124	Coarse loamy, mixed	Borollic Haplargid	Aridisol
146	Fine loamy, mixed	Borollic Haplargid	Aridisol
147	Fine loamy, mixed	Borollic Haplargid	Aridisol
148	Fine loamy, mixed	Ustic Torriorthent	Entisol
150	Coarse Loamy, mixed	Pachic Cryoboroll	Mollisol
163	Fine, mixed	Typic Cryoboroll	Mollisol
168	Coarse loamy, mixed	Pachic Cryoboroll	Mollisol
169	Loamy-skeletal, mixed	Typic Cryochrept	Inceptisol
170	Loamy-skeletal, mixed	Typic Cryochrept	Inceptisol
171	Fine loamy, mixed	Pachic Cryoboroll	Mollisol
172	Loamy-skeletal, mixed	Cumulic Cryoboroll	Mollisol

ENGINEERING CLASSIFICATION SYSTEMS

Two systems of classifying the soils are in general use among engineers. Most highway engineers classify soil materials according to the system used by the American Association of State Highway Officials (ASSHO). This system is based on grain-size distribution, liquid limit, plasticity index, and field performance of soils in highways. In the ASSHO system, soil materials are classified in seven principle groups ranging from A-1, which consists of gravelly soils having high bearing strength, i.e. the best soils for road subgrade, to A-7, which consists of clayey soils having low bearing strength, i.e. the poorest soils for road subgrade.

The other system is the Unified Classifications System. It is established by the Corps of Engineering, U. S. Army. In this system, soils are classified according to the particle-size distribution, plasticity index, liquid limit, and organic matter. In this system the soils are identified as coarse grained, fine grained, and highly organic.

Soil Properties Significant to Engineering

Several estimated soil properties significant in engineering are given in Tables 20 to 34. These estimates are made for typical soil pedons by layers sufficiently different to have different significances for soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kind of soil in other places.

Engineering Interpretations

The estimated interpretations of soils in this report are based on the soil properties significant to engineering, on test data for soils in the survey area or others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of the area. Ratings are used to summarize limitation or suitability of soils for all listed purposes other than for drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments. For these particular uses, engineering soil features must not be overlooked in planning, installation, and maintenance.

Soil limitations are indicated by the ratings slight, moderate, and severe. "Slight" means soil properties generally favorable for the rated use. "Moderate" means that some soil properties are unfavorable but can be overcome or modified by special planning and design. "Severe" means soil properties so unfavorable and so difficult to correct or overcome as to require major soil reclamation, special designs, or intensive maintenance.

Soil suitability is rated by the terms, good, fair, and poor, which have, respectively, meanings approximately parallel to the terms slight, moderate, and severe. Engineering interpretations are listed in Table 20 through 34, respectively.

Table 20. Soil properties and interpretations for pedon 22.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 22 Soil Classification: Typic Cryoboralf, very fine, mixed; 10 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-66	Sandy loam, 7-8% clay	SM	A2 or A3	0	95-100	95	50-70	15-25	15-25	0-5	<0.15
66-131	Clay, 61-84% clay	CH	A-7	0	100	100	90-100	80-95	60-70	45-55	

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-66	0.08	1.73	5.0-5.9	8.0	0.2	—	Low	>150	D	Low	—	.24	4	3
66-131	0.18		4.4-5.2	1.3	0.2-0.4	—	High							

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Severe; permeability	Severe; slope	Severe; bedrock at 131 cm, clayey material	Moderate; slope	Severe; clay below 66 cm	Moderate; slope

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Severe; shrink-swell potential	Severe; shrink-swell potential	Severe; shrink-swell potential	Poor; shrink-swell potential	Unsuitable; clay below 66 cm	Fair; coarse fragments slope

RECREATION USE - LIMITATION FOR CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	POTENTIAL AS WILDLIFE HABITAT Openland	Woodland	Wetland	Rangeland
Severe; permeability	Slight	Severe; slope 10%	Slight	Poor	Good	Very poor	Good

Table 21. Soil properties and interpretations for pedon 116.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 116 Soil Classification: Borollic Haplargid, clayey-skeletal, mixed, 6 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-60	Sandy clay loam, 26-30% clay	CL or ML	A6 or A7	10	70-80	70-75	60-70	30-40	35-45	10-20	0.5-1.5
60	Bedrock										

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-60	.18	10.8	7.2-7.6	.76	.5	--	Moderate	>150	B	Low	--	.15	2	5

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Severe; permeability	Severe; depth to bedrock	Severe; depth to bedrock	Slight	Fair; thickness 60 cm	Severe; depth to bedrock

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Moderate; low strength, shrink-swell potential	Moderate; low strength, shrink-swell potential	Moderate; low strength; shrink-swell potential	Fair; low strength; shrink-swell potential	Unsuitable; high in fines	Poor; coarse fragment

RECREATION USE - LIMITATION FOR CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	POTENTIAL AS WILDLIFE HABITAT Openland	Woodland	Wetland	Rangeland
Moderate; surface texture	Moderate; surface texture	Moderate, permeability, slope	Moderate; surface texture	Poor	Fair	Very poor	Fair

Table 22. Soil properties and interpretations for pedon 120.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 120 Soil Classification: Aridic Haploboroll, fine loamy, mixed, 2 percent slope.

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-100	Sandy clay loam, 25-33% clay	SC	A-6	0	100	100	80-90	35-55	30-35	10-15	1.5-2.5
100	Bedrock										

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-100	.18	18	6.7-8.5	.9	.3-.6	—	Moderate	>150	B	Moderate	—	.02	2	5

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Severe; depth to bedrock	Severe; depth to bedrock	Severe; depth to bedrock	Slight	Fair; depth to bedrock	Severe; depth to bedrock

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Moderate; shrink-swell potential	Moderate; shrink-swell potential, depth to bedrock	Moderate; shrink-swell potential, susceptible to frost action	Fair; shrink-swell potential susceptible to frost action	Unsuitable; high in fines	Fair; texture

RECREATION USE - LIMITATION FOR				POTENTIAL AS WILDLIFE HABITAT			
CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	Openland	Woodland	Wetland	Rangeland
Moderate; surface texture	Moderate; surface texture	Moderate; texture	Moderate; surface texture	Poor	Fair	Very poor	Fair

Table 23. Soil properties and interpretations for pedon 121.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 121 Soil Classification: Borollic Haplargid, fine mixed, 6 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-20	Sandy loam to loam, 10-20% clay	CL-ML	A-4	0	95-100	90-95	70-80	60-70	20-30	5-10	0.5-1.5
20-130	Loam to clay loam, 25-30% clay	CL	A-6	0	90-95	90	75-85	60-65	30-35	10-15	
130	Bedrock										

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-20	.12	12.6	8.1-8.2	.8	.3-.4	--	Low	>150	B	Low	--	.24	4	3
20-130	.17		8.2-8.4	.9	.5-.8	--	Low							

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Severe; permeability	Moderate; slope	Severe; depth to bedrock	Slight	Good	Moderate; depth to bedrock

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Moderate; low strength	Moderate; low strength	Moderate; low strength	Fair; low strength	Unsuitable; high in fines	Fair; texture, coarse fragments

RECREATION USE - LIMITATION FOR CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	POTENTIAL AS WILDLIFE HABITAT Openland	Woodland	Wetland	Rangeland
Moderate; permeability	Slight	Moderate; slope, permeability	Slight	Poor	Fair	Very poor	Fair

Table 24. Soil properties and interpretations for pedon 124.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 124 Soil Classification: Borollic Haplargid, coarse loamy, mixed, 4 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-97	Sandy loam to silt loam, 12-21% clay	CL-ML	A-4	5-10	40-100	90-100	70-100	60-90	20-30	5-10	1.5-2.5
97-127	Sandy loam, 16% clay	GC-GM	A-1 or A-2	0	50-55	45	25-30	10-15	20-25	5-10	

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-97	.17	18.6	8.1-8.2	1	.5-1.1	--	Low	>150	B	Moderate	--	.37	2	3
97-127	.07		7.9	4.5	3.4	--	Low							

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Moderate; permeability	Moderate; slope	Slight	Slight	Good	Slight

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Moderate; susceptible to frost action	Moderate; susceptible to frost action	Moderate; susceptible to frost action	Fair; susceptible to frost action, low strength	Unsuitable; high in fines	Fair; coarse fragments

RECREATION USE - LIMITATION FOR CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	POTENTIAL AS WILDLIFE HABITAT Openland	Woodland	Wetland	Rangeland
Slight	Slight	Moderate; slight	Slight	Poor	Fair	Very poor	Fair

Table 25. Soil properties and interpretations for pedon 146.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 146 Soil Classification: Borollic Haplargid, fine loamy, mixed, 4 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-77	Sandy loam, 10-19% clay	SC-SM	A-2	0	95-100	95	60-65	30-35	25-30	5-10	5-15
73-100	Sandy loam, 16% clay	SC-SM	A-2	30	65-70	60-65	30-45	15-25	20-25	5-10	

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-72	.11	11	7.1-7.8	.8	.3-.5	--	Low	>150	B	Low	--	.29	3	3
72-100	.11		8.2		.5	--	Low							

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Slight	Severe; permeability	Severe; permeability	Severe; permeability	Good	Moderate; gravelly below 73 cm

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Slight	Slight	Slight	Good	Unsuitable; SC-SM material	Good

RECREATION USE - LIMITATION FOR CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	POTENTIAL AS WILDLIFE HABITAT Openland	Woodland	Wetland	Rangeland
Slight	Slight	Moderate; slope 4%	Slight	Poor	Fair	Very poor	Fair

Table 26. Soil properties and interpretations for pedon 147.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 147 Soil Classification: Borollic Haplargid, fine loamy; mixed, 3 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 3 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-9	Sandy loam, 11% clay	SM	A-2 or A-4	0	100	100	60-70	30-40	20-25	0-5	1.5-2.5
9-95	Loam, 22-27% clay	ML-CL	A-4	0	95-100	90-95	80-85	60-70	25-30	5-10	

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-9	.11	16.1		1.2	.6	--	Low	>150	B	Low	--	.28	3	3
9-95	.18			1.3	.4-.5	--	Low							

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Moderate; permeability	Moderate; permeability	Slight	Slight	Good	Slight

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Moderate; low strength	Moderate; low strength	Moderate; low strength	Fair; low strength	Unsuitable; high in fines	Good

RECREATION USE - LIMITATION FOR CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	POTENTIAL AS WILDLIFE HABITAT Openland	Woodland	Wetland	Rangeland
Slight	Slight	Moderate; slope	Slight	Poor	Fair	Poor	Fair

Table 27. Soil properties and interpretations for pedon 148.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 148 Soil Classification: Ustic Torriorthent, fine loamy, mixed, 8 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-48	Sandy loam to loam, 16-24% clay	SC-SM	A-4	0	75-80	70-75	60-65	35-45	25-30	5-10	2.5-5
48	Shale bedrock										

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-48	0.13	6.2	7.8-8.0	.7	.5-1.0	--	Low	>150	B	Moderate	--	.22	1	3

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Moderate; slope, depth to bedrock	Severe; slope	Severe; depth to bedrock	Slight	Poor; thickness 48 cm	Severe; depth to bedrock, gravelly

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Moderate; susceptible to frost action	Moderate; susceptible to frost action	Moderate; susceptible to frost action; low strength	Fair; susceptible to frost, low strength	Unsuitable; high in fines	Poor; coarse fragments

RECREATION USE - LIMITATION FOR				POTENTIAL AS WILDLIFE HABITAT			
CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	Openland	Woodland	Wetland	Rangeland
Slight	Slight	Severe; slope 8%	Slight	Poor	Fair	Very poor	Fair

Table 28. Soil properties and interpretations for pedon 150.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 150 Soil Classification: Pachic Cryoboroll, coarse loamy, mixed, 30 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >3 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-98	Sandy loam, 12-13% clay	SM-SC	A-2	0	95-100	95	60-65	30-35	20-25	5-10	1.5-5
98-115	Sandy loam, 13% clay	SM-SC	A-2	40-45	60-65	55-60	30-40	15-25	20-25	5-10	1.5-5

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-98	.11	11.8	5.5-6.1	1	.3-1.4	--	Low	>150	B	Moderate	--	.14	3	3
98-115	.06		6.0	1.3		--	Low							

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Severe; slope	Severe; slope	Severe; slope	Severe; slope	Poor; slope	Severe; slope

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Severe; slope	Severe; slope	Severe; slope	Poor; slope	Unsuitable; high in fines	Poor; slope

RECREATION USE - LIMITATION FOR CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	POTENTIAL AS WILDLIFE HABITAT Openland	Woodland	Wetland	Rangeland
Severe; slope	Severe; slope	Severe; slope	Severe; slope	Poor	Good	Very poor	Good

Table 29. Soil properties and interpretations for pedon 163.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 163 Soil Classification: Typic Cryoboroll, fine, mixed, 8 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-19	Loam, 24% clay	CL-ML	A-4	0	100	100	85-90	60-75	25-30	5-10	.15-.5
19-40	Silt clay loam, 38% clay	CL	A-6	0	100	100	90-100	95-100	35-45	15-20	
40-95	Silt clay, 42-44% clay	CL	A-7	5-10	95-100	95-95	85-95	80-90	40-45	20-25	

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-19	0.17	16.0	6.2	0.37	0.5	--	Moderate	>150	B	Low	--	.37	3	5
19-40	0.18		6.6	0.40	0.4	--	Moderate							
40-95	0.16		6.8-7.7	0.90	0.3-0.4	--	Moderate							

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Severe; permeability, depth to bedrock	Severe; slope	Severe; too clayey	Slight	Fair; thickness 95 cm	Moderate; slope, clayey

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Moderate; shrink-swell potential, low strength	Moderate; shrink-swell potential, low strength	Severe; low strength	Fair; shrink-swell potential, low strength	Unsuitable; high in fines	Fair; texture, slope

RECREATION USE - LIMITATION FOR CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	POTENTIAL AS WILDLIFE HABITAT Openland	Woodland	Wetland	Rangeland
Moderate; permeability	Slight	Severe; slope	Slight	Poor	Good	Very poor	Good

Table 30. Soil properties and interpretations for pedon 168.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 168 Soil Classification: Pachic Cryoboroll, coarse loamy, mixed, 5 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLAS-TICITY INDEX	PERMEABILITY (CM/HR)
0-85	Sandy loam to loamy sand, 7-9% clay	SM	A-2	0	90-95	85	50-60	25-30	20-25	0-5	1.5-5
85-110	Sandy loam, 5-8% clay	GM or SM	A-1 or A-2	45	55-60	55	30-35	15-20	20-25	0-5	2.5-5

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DIS-PERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-85	0.08	8.3	6.3	0.7	0.2-0.5	--	Low	>150	B	Moderate	--	.17	3	3
85-110	0.06		6.6	4.0	0.2	--	Low							

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Severe; slope	Severe; slope	Severe; slope	Poor; slope	Poor; slope	Severe; slope

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Severe; slope	Severe; slope	Severe; slope	Poor; slope	Poor; high in fines	Poor; slope

RECREATION USE - LIMITATION FOR CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	POTENTIAL AS WILDLIFE HABITAT Openland	Woodland	Wetland	Rangeland
Severe; slope	Severe; slope	Severe; slope	Severe; slope	Poor	Good	Very poor	Good

Table 31. Soil properties and interpretations for pedon 169.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 169 Soil Classification: Typic cryochrept, loamy-skeletal, mixed 45 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-35	Sandy loam, 8-9% clay	SM	A-2	0	80-90	80	45-55	25-30	20-25	0-5	5-15
35-90	Sandy loam, 6-9% clay	SM	A-1 or A-2	35	70-75	65-70	35-45	15-25	20-25	0-5	
90-115	Sandy loam, 10-11% clay	GM or SM	A-1	35	55-60	50-55	30-40	15-20	20-25	0-5	

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (PH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-35	0.09	8.5	5.6-6.0	2.5	0.2	--	Low	>150	B	Moderate	--	.28	2	3
35-90	0.07		5.9	3.3	0.2	--	Low							
90-115	0.06		6.5	3.4	0.2	--	Low							

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Severe; slope	Severe; slope, permeability	Severe; slope, permeability	Severe; slopes	Poor; slope	Severe; slope

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Severe; slope	Severe; slope	Severe; slope	Poor; slope	Poor; high in fines	Poor; slope

RECREATION USE - LIMITATION FOR CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	POTENTIAL AS WILDLIFE HABITAT Openland	Woodland	Wetland	Rangeland
Severe; slope	Severe; slope	Severe; slope	Severe; slope	Poor	Good	Very poor	Good

Table 32. Soil properties and interpretations for pedon 170.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 170 Soil Classification: Typic Cryochrept, loamy-skeletal, mixed, 30 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-10	Loam, 20-22% clay	SM-SC CM-GC	A-4	35	70-75	65-70	55-60	40-45	25-30	5-10	1.5-5
10-60	Loam, 22-26% clay	CM-GC	A-4	45	60-65	55-60	50-55	35-40	25-30	5-10	1.5-2.5

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-10	0.10	6.4	7.0	0.8	0.7	--	Low	>150	B	Moderate	--	.18	1	3
10-60	0.09		7.2-7.9	1.7	0.4-0.6	--	Low							

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Severe; slope	Severe; slope	Severe; slope	Severe; slope	Poor; slope	Severe; slope

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SUITABILITY AS A SOURCE OF SAND AND GRAVEL	SUITABILITY AS A SOURCE OF TOPSOIL
Severe; slope	Severe; slope	Severe; slope	Poor; slope	Unsuitable; high in fines	Poor; slope

RECREATION USE - LIMITATION FOR CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	POTENTIAL AS WILDLIFE HABITAT Openland	Woodland	Wetland	Rangeland
Severe; slope	Severe; slope	Severe; slope	Severe; slope	Poor	Good	Very poor	Good

Table 33. Soil properties and interpretations for pedon 171.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 171 Soil Classification: Pachic Cryoboroll, fine loamy, mixed, 18 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-90	Sandy loam to sandy clay loam, 16-23% clay	SM-SC	A-2 or A-4	0	95-100	95-100	60-70	30-40	20-30	5-10	2.5-5
90-115	Sandy loam, 19% clay	GM-GC	A-2	0	50-55	45	30-35	15-20	25-30	5-10	5-15

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-90	0.11	12.6	6.2-7.9	0.7	0.2-0.3	--	Low	>150	B	Moderate	--	.17	3	3
90-115	0.11		7.8	1.2	0.4	--	Low							

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Severe; slope	Severe; slope	Severe; permeability	Severe; slope	Poor; slope	Severe; slope

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Severe; slope	Severe; slope	Severe; slope	Fair; susceptible to frost action	Unsuitable; high in fines	Poor; slope

RECREATION USE - LIMITATION FOR CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	POTENTIAL AS WILDLIFE HABITAT Openland	Woodland	Wetland	Rangeland
Severe; slope	Severe; slope	Severe; slope	Moderate; slope	Poor	Good	Very poor	Good

Table 34. Soil properties and interpretations for pedon 172.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 172 Soil Classification: Cumulic Cryoboroll, loamy-skeletal, mixed, 4 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-52	Sandy loam, 10-16% clay	SM, SM-SC	A-2 or A-4	0	100	100	60-70	30-40	20-25	5-10	5-15
52-93	Sandy	GP or GW	A-1	0	25-30	25	10-15	0-5	NP	--	

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-52	0.11	6.9	6.2-7.0	0.5	0.3-0.5	--	Low	>150	A	Moderate	--	.17	2	3
52-93	0.03		5.5-6.8	0.3	0.2-0.3	--	Low							

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Slight	Severe; permeability	Severe; permeability	Severe; permeability	Fair; thickness 95 cm	Moderate; gravelly below 93 cm

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Slight	Slight	Slight	Good	Poor: to depth 52 cm; good: below depth 52 cm	Good

RECREATION USE - LIMITATION FOR				POTENTIAL AS WILDLIFE HABITAT			
CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	Openland	Woodland	Wetland	Rangeland
Slight	Slight	Moderate; slope	Slight	Poor	Fair	Very poor	Fair

CONCLUSIONS

These soils are presently used for range, wildlife and watersheds. In their present condition the soils have a good potential for these uses. The range condition on the Borollic Haplargids of Wiregrass Bench is poor but the potential for improvement is good under proper management. Within the limits of this investigation the soils of the study area would provide good cover material for mine spoil reclamation in case the area is disturbed for the extraction of coal.

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VITA

Amjad T. El-Rihani

Candidate for the degree of

Master of Science

Report: Interpretation of Selected Soil Data from the Central Part of Utah

Major Field: Soil Genesis and Classification

Biographical Information:

Personal Data: Born at Husn, Jordan, December 23, 1945, son of Tuma El-Rihani and Fareeda El-Rihani; married Nabeela El-Rihani in 1974. Have 3-year-old daughter, Luna, and 2 year-old-son, Hesham.

Education: Attended elementary school in Husn, Jordan; graduated from Irbid High School in 1966; received Bsc degree in soils from Cairo University in 1970; completed requirements for M.S. degree at Utah State University in 1977.

Professional Experience: Government service in Jordan 1971-1976; worked as a soil survey technical officer in dryland farming project.

Table 33. Soil properties and interpretations for pedon 171.

SOIL PROPERTIES AND INTERPRETATIONS

Pedon No. 171 Soil Classification: Pachic Cryoboroll, fine loamy, mixed, 18 percent slope

ESTIMATED ENGINEERING PROPERTIES

DEPTH (CM)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >8 CM (PCT)	PERCENT OF MATERIAL LESS THAN 8 CM PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX	PERMEABILITY (CM/HR)
0-90	Sandy loam to sandy clay loam, 16-23% clay	SM-SC	A-2 or A-4	0	95-100	95-100	60-70	30-40	20-30	5-10	2.5-5
90-115	Sandy loam, 19% clay	GM-GC	A-2	0	50-55	45	30-35	15-20	25-30	5-10	5-15

DEPTH (CM)	AVAILABLE WATER CAPACITY (CM/CM)	(CM/PROFILE)	SOIL REACTION (pH)	EXCH. SODIUM (PCT)	SALINITY (MMHOS/CM)	DISPERSION	SHRINK-SWELL POTENTIAL	WATER TABLE DEPTH (CM)	HYD GRP	POTENTIAL FROST ACTION	SETTLEMENT POTENTIAL	EROSION FACTORS K	T	WIND EROSION GROUP
0-90	0.11	12.6	6.2-7.0	0.7	0.2-0.3	--	Low	>150	B	Moderate	--	.17	3	3
90-115	0.11		7.8	1.2	0.4	--	Low							

INTERPRETATIONS OF SOIL - LIMITATION RATINGS & DOMINANT SOIL FEATURES AFFECTING USE FOR

SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	TRENCH TYPE SANITARY LANDFILLS	AREA TYPE SANITARY LANDFILL	COVER, AREA TYPE SANITARY LANDFILL	SHALLOW EXCAVATIONS
Severe; slope	Severe; slope	Severe; permeability	Severe; slope	Poor; slope	Severe; slope

DWELLINGS WITHOUT BASEMENTS	DWELLINGS WITH BASEMENTS	LOCAL ROADS AND STREETS	SUITABILITY AS A SOURCE OF ROADFILL	SAND AND GRAVEL	TOPSOIL
Severe; slope	Severe; slope	Severe; slope	Fair; susceptible to frost action	Unsuitable; high in fines	Poor; slope

RECREATION USE - LIMITATION FOR CAMP AREAS	PICNIC AREAS	PLAYGROUNDS	PATHS AND TRAILS	POTENTIAL AS WILDLIFE HABITAT Openland	Woodland	Wetland	Rangeland
Severe; slope	Severe; slope	Severe; slope	Moderate; slope	Poor	Good	Very poor	Good